DOCUMENT RESUME

ED 115 252 IR 002 796

AUTHOR Burns, Robert W., Jr.
TITLE Library Performance Measures as Seen in the Descriptive Statistics Generated by a Computer Managed Circulation System.
PUB DATE 5 Sep 75
NOTE 74p.

EDRS PRICE MF-$0.76 HC-$3.32 Plus Postage
DESCRIPTORS College Libraries; Computer Oriented Programs; Data Collection; Library Administration; *Library Automation; *Library Circulation; Library Planning; *Management Information Systems; On Line Systems; *Performance Criteria; *Statistical Data; University Libraries

ABSTRACT

A study was conducted to inventory and describe the quantitative performance measures of an academic library system which originate as a result of the activities at an automated loan desk. Visits were made to 24 academic libraries whose experience in library automation ranged from the completely on-line system with user self service and in-house computer to the wholly batch oriented system. It was concluded that with the exception of a few outstanding examples, there is little sophistication in the collection, manipulation, or use of the statistical management data now being produced by computer automated circulation systems for the support of library planning/operational functions. Libraries need to exploit the work already done on quantitative performance measures in both business and higher education. (Author/PF)

****
* Documents acquired by ERIC include many informal unpublished *
* materials not available from other sources. ERIC makes every effort *
* to obtain the best copy available. Nevertheless, items of marginal *
* reproducibility are often encountered and this affects the quality *
* of the microfiche and hardcopy reproductions ERIC makes available *
* via the ERIC Document Reproduction Service (EDRS). EDRS is not *
* responsible for the quality of the original document. Reproductions *
* supplied by EDRS are the best that can be made from the original. *
****

ED115252

LIBRARY PERFORMANCE MEASURES AS SEEN IN THE DESCRIPTIVE STATISTICS GENERATED BY A COMPUTER MANAGED CIRCULATION SYSTEM

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

by

Robert W. Burns, Jr.

Assistant Director of Libraries

for Research Services

Fort Collins, Colorado, Colorado State University Libraries, August, 1975

IR 002 796

ACKNOWLEDGEMENT

This investigation was performed while the author was a Council on Library Resources Fellow during a sabbatical leave from the Colorado State University Libraries. The author wishes to acknowledge with thanks the contribution of both the Council and of Colorado State University Libraries to this effort. Sincere thanks are also extended to all those staff members in libraries over the U.S. and Canada who answered questions and put up with irregular arrival and departure hours. Their patience and understanding are a tribute to the profession. Lastly, the author wishes to thank the CSU Director of Libraries, Dr. LeMoyne W. Anderson, who has always insisted upon quality over quantity.

Robert W. Burns, Jr.

September 5, 1975

CONTENTS

		Page
I.	INTRODUCTION	
	A. Background and Setting for this Study.	1
	1. The Place of Circulation in the Collection of Management Data in Libraries.	1
	2. Automated Circulation Systems and their Characteristics.	2
	3. The Library Statistic and Goal Setting.	3
	4. Library Performance Measures as Seen in the Circulation System.	4
	B. The Problem Examined by this Study.	6
	C. Goals of this Study.	7
	D. Methodology and Related Problems.	8
II.	FINDINGS	
	A. Operational Characteristics of the Libraries Surveyed.	10
	B. Findings Directly Related to the Research Goals of this Study.	12
	C. General Findings and Observations Relating to Automated Circulation Systems in the Libraries Surveyed.	22
	D. General Observations Relating to the Operation of the Libraries Surveyed.	26
III.	DEVELOPING TRENDS IN CIRCULATION SERVICE	28
IV.	THE LIBRARY STATISTIC AS A MANAGEMENT TOOL	29
V.	LITERATURE REVIEW	33
VI.	FUTURE RESEARCH NEEDS	37
VII.	CONCLUSIONS	39
VIII.	RECOMMENDATIONS	43
IX.	BIBLIOGRAPHY	45
X.	TABLES	56
XI.	APPENDIX	63

TABLES

1. Quantitative Performance Measures and their Use in the Twenty-Four Academic Libraries Surveyed.

2. Reactions of Respondents to the Question, "How Satisfied Are You with the Statistical Management Data You Collect from Your Automated Circulation System?"

   A. Aggregate of All Replies.

   B. Percentage of Replies by Position (Status) of Respondent.

3. Reporting Cycles Presently in Use by Libraries and Their Frequency of Occurrence.

4. Hardware Used by or Supporting Existing Computer Driven Circulation Systems in Batch, On-Line or Quasi-Batch Modes.

5. Loan Periods in Use and Their Frequency of Occurrence.

APPENDIX

A. Interview Check Sheet.

B. List of Libraries Surveyed with Dates - Staff Interviewed.

ABBREVIATIONS AND SYMBOLS USED IN THIS REPORT

Abbreviations:

BC	Book Card
CACS	Computer Assisted Circulation System(s)
c/tab	Cross Tabulated
c/o	Charged Out
DB	Data Base
F/Y	Fiscal Year
LC	Library of Congress
M/R	Machine Readable
MIS	Management Information System
MTD	Month to Date
OD	On Demand. Requires a request from the Library to Produce
OR	Operations Research
P/O	Computer Print Out
Qtr	Quarterly
UC	The University Computer Center
UG	Undergraduate
YTD	Year to Date

I. INTRODUCTION

A. Background and Setting for this Study

In its 1972 report on Libraries and Information Technology: A National System Challenge, The National Academy of Sciences (97, p. 5) observed that "...Comprehensive, consistent, and timely data on actual services rendered... must be obtained and presented to provide a firm basis for planning and decision-making in developing and evaluating coherent programs..." of library service. This need for better operational data is a problem which has been gnawing at the library profession for many years.

The computer is often presented as one answer to the manager's need for the easy accumulation of information about the operation of his organization. No one will seriously challenge the ability of the computer to collect, manipulate, summarize, and print on request mountains of data. Yet today, for better or for worse, libraries are faced with precisely those same problems which confronted private enterprise when it attempted to use the computer as a source of management information over ten years ago. The following quote was taken from an article written by Moravec in 1965. "...Present-day data processing systems are pouring forth more information than anyone can ever hope to assimilate under present circumstances. The ability to generate information has outrun the ability to comprehend it..." (89, p. 44). It is still possible for libraries to avoid many of these early mistakes by carefully studying the solutions adopted by private enterprise.

The critical questions which must be answered in seeking a solution to management's need for comprehensive, consistent and timely data are: How to make management information relevant to the problems faced by an administrator at the moment the problem arises, how to keep out extraneous data through summary, how to anticipate what the administrator will require before his needs become explicit, and how to maintain a level of accuracy consistent with the requirements of the problem on the administrator's desk. In essence these are the strategic design requirements needed by the designer of a management information system and are absolutely essential conditions for its acceptance by the user. Many clues to the development of an MIS for libraries surfaced during the course of this investigation and will be discussed in this report as the preliminary design requirements of a generic MIS for academic library administrators.

1. The Place of Circulation in the Collection of Management Data in Libraries. For management purposes libraries are best thought of as composed laterally of a series of activity centers and vertically as a hierarchy of authority/responsibility points controlling these activity centers. Information flows both horizontally from activity center to activity center and vertically from authority point to authority point. For the convenience of management, these clusters of related activities have been made into administrative units which are related either functionally or operationally or both. The Circulation Department is only one of many such centers which make up a library. It is characteristic of these centers that none can operate in isolation and that each is inextricably bound to every other one

in ways both obvious and devious. Each influences and is influenced by every other in a series of delicate administrative balances analogous to the mobiles of Alexander Calder. For example, one interface between acquisitions and circulation lies in the statistical data accumulated as a consequence of circulation activities. Such data has been used to guide policy in collection development as well as in the purchase of duplicate copies of heavily used material.

It is a basic tenet of this paper that academic library circulation operations constitute a rich source of information about many of the activities taking place within a library, the use being made of that library, the demographic and intellectual characteristics of its users, as well as a measuring stick for gauging the success of current library policies and a lightning rod for its mistakes. For a librarian to measure circulation activities is analogous to a doctor taking the pulse of a patient. Both provide excellent diagnostics of the vigor and health of the patient. It is unfortunate, therefore, that more attention has not been paid to the management potential inherent in such data as well as to what is currently being accomplished in analogous situations in the business world. The reasons for this are not difficult to discover and were summed up quite well in a recent report from the Commission on Management of Research Libraries given in the minutes of an ARL meeting (90, p. 97). "...Neither academic institutions nor their libraries have invested significant time or money in improving management practices..."

2. Automated Circulation Systems and their Characteristics. Library circulation operations are defined here as those activities connected with the use and control of a libraries stock after the volume (piece) is acquired and processed for public use (130). The heart of circulation centers in this "control" function and contains a number of sub-routines all related to this function, such as charging, returning, renewing, reserving, moving to the shelf, as well as a concern with the files and documents related to these activity centers. Laurence Miller (115) has provided an excellent survey of circulation services as seen in 103 major academic libraries.

Circulation is best viewed as a large scale dynamic system which is transaction oriented and lies directly on the interface between user and library. Events here are both volatile and discrete while behaving like a continuing stream which a systems analyst may study either by monitoring its flow or by taking a "photograph" of its activities.

Some of the most sensitive indicators of a libraries operational health are to be found in those activities which take place at or around the loan desk. It is a critical area with many yardsticks on which to measure library success. Transactions which take place there are characterized by their high volume, lack of a source or backup document, high volatility, need for an audit trail, and are stored as large files composed of many small records. Circulation transactions are usually identified by a transaction number and arranged by a call number. This author found several examples of call numbers being used as transaction numbers among the libraries visited but not the obverse. Transaction numbers are usually composed only of numeric characters while call numbers consist of alphas, numerics, special characters and occasionally blanks.

One of the characteristics of loan desk operations which makes preparation of their statistics so difficult is the paired nature of most transactions coupled with their extreme instability and high volume referred to earlier. For every charge there is normally a matching return such that a charge followed by another charge or a return followed by another return is usually considered to be an error condition. Interestingly enough this was not found to be true in all cases studied here. One automated circulation system permitted a charge to be followed by a charge in renewing items. Nevertheless, this behavior was atypical and not characteristic of circulation systems. This pairing of transactions means that a high percentage of errors will inadvertently creep into the system through ignorance or carelessness, and errors will cause circulation statistics to vary such that daily figures cannot be summed to equal monthly cumulations, nor will monthlies equal quarterlies etc. Another difficulty in creating and using circulation statistics stems from the ever growing nature of the file with the necessity for occasionally switching to an additional storage medium - from one tape to another or from one to a second disc. At no time in its history does a circulation data base contain only the records of completed transactions or only the records of incomplete transactions. It is always an unstable mix of both groups such that file handling becomes an especially troublesome operation. Typical of the problems encountered is the fact that charges will seldom equal returns for any given time period.

It is also characteristic of a circulating collection that a small percentage of the total holdings will account for a major share of the items circulated. For example, Trueswell found that "...50 percent of the holdings is satisfying 99 percent of the user - circulation requirements..." in a public library (107, p. 459) and that "...93% of the circulation came from 60% of the holdings..." in a university library (108, p. 205). Guthrie and Yagello (109) reported similar behaviour in a Physics Library on the Ohio State University campus where 3.7% of the titles accounted for 56.1% of the circulation activity. This leaves unanswered, however, the question as to whether the circulating titles remain the same over time or from one to another library. Thus, while we know with some certainty that a limited portion of the total collection constitutes a major share of circulation activity, we do not know whether the population of titles "in demand" remains the same from library to library or from time period A to time period B. Despite these problems, loan desk activities are relatively easy to quantify in terms of how many, how long, how often, or how large.

3. The Library Statistic and Goal Setting. The collection of library statistics and their use in measuring goal achievement has been a source of much controversy in the library profession. Success in achieving a goal implies the making of a qualitative judgement based upon variables which do not always lend themselves easily to quantification. It is worth noting that most conclusions as to a library's success in reaching its goals can be made only after one extrapolates from the quantitative to the qualitative by means of an intellectual/professional judgement. Those who debate the dichotomy of qualitative vs. quantitative measures of success have failed to grasp this fundamental sequential relationship between the two and the fact that both are essential components in the process of gauging library success/non-success. Extrapolation from one value system to the other must be done as a separate exercise with its own rules and constraints.

4. Library Performance Measures as Seen in the Circulation System. The main thrust of this investigation is toward cataloging these quantitative measures of library performance as they surfaced in the operation of an academic library's loan desk. This report will emphasize the quantitative with occasional excursions into the complex world of qualitative performance measures. The major emphasis in this paper, however, will be toward describing those quantitative performance measures currently in use by academic library circulation systems.

From the very beginning of automated circulation systems librarians and systems designers have been aware of the potential computers possess for the collection, storing, monitoring, and manipulating of statistical information about a library. Palmer (3, p. 2) points out in his collection of case studies involving library automation that most library circulation systems provide, "Programs that readily and economically compile an array of statistics and summaries to aid efficient library management, including analyzing the pattern of circulation activity...." He (3, p. 3) goes on to sound a note of warning, however, that "...librarians are well advised not to have computers collect data simply because computers can...."

Such data can provide clues to collection development, the characteristics of the user population, current physical housing requirements of the collection, the success and/or acceptance of library policies, as well as long range forecasts for each of the above. Yet nowhere did this author find a full utilization of the computer's potential to perform all of the above tasks. Interest in and awareness of the needs and potentials of such a management information system abounded, but there was no completely integrated MIS either in use or in the design stages for an academic library uncovered by this investigation. Indeed, the operation and maintenance of existing circulation systems is so demanding as to preclude investigation or work along the lines outlined above in all but a few institutions. A few tentative starts (121, 128, 129) have been made. Nevertheless, as this survey discovered, existing systems possess only limited sophistication in their statistics, utilize a very cursory analysis of data confined to the arithmetic functions (sometimes with percentages), and are full of operational and semantic ambiguities which would make their extrapolation from library to library especially difficult.

There were surprisingly few discussions in the literature of actions taken as a consequence of data which had been developed by a CACS. Paulukonis (7, p. 17) at Northwestern and Miller (116, p. 92) at SUNYAB mention changes in the length of the loan period. Palmer (3, p. 17) points to an "...analysis of circulation activity...used in ordering materials... and in developing policies and procedures of the reserve office..." in the University of Michigan closed reserve system. Simmons (70, 135) notes a case study of the analysis of machine readable loan records and how they were used to select items for the collection as well as duplicate present holdings at the University of British Columbia. A few additional examples were unearthed in the course of this investigation and will be discussed elsewhere in this report. There were numerous examples in the literature, however, of studies which were conducted using data obtained from circulation statistics. These will be discussed in the literature review which accompanies this report.

The computer has opened up tremendous opportunities for developing a more responsive circulation system. Typical of these opportunities are the use of a variable loan period dependent upon the number of charges made for a given item, the easy identification of heavily used items or portions of the collection as well as delinquent users, the monitoring of collection growth rates compared with the available shelving, the opportunity to obtain and use more viable performance measures, and finally the monitoring of user patterns and characteristics.

Performance measures are measures of output or service. They can be subdivided into effectiveness measures and efficiency measures. Elton and Vickery (76, p. 308) pointed out that "...a performance measure provides a quantitative assessment of how good is the output of a system with respect to some criterion..."; while Evans, Borko and Ferguson (99, p. 108) make "use as a criterion concept...basic to all performance evaluations...." The choice of a viable performance measure is thus crucial to the process of management.

Effectiveness (98, Phase II, p. 7) has been defined as "...the extent or degree to which a particular thing fulfills the mission, goal or objective for which it was performed, that is, the degree to which it meets the standard set by authority...." Effectiveness is goal oriented. Efficiency is operationally oriented. Typical measures of effectiveness are the number of satisfied users, successful reference questions answered, and a ratio of the number of items desired compared with the number acquired; in other words measures for determining the degree of a libraries success in meeting its goals. The key test required to differentiate between effectiveness and efficiency is that the former measures goal satisfaction while efficiency measures operational success. Efficiency measures are concerned with such things as a library's work load - the number of charges, returns, renewals, holds placed, or people going through a door. Much of the confusion in library performance measures has resulted from using these two interchangeably. For example, the use as an effectiveness measure in an annual report of the activity at a loan Desk. Indeed, much of the quality vs. quantity debate stems from the confusion between these two. One can increase or raise efficiency statistics with no assurance that effectiveness will also increase. Shortening the time a book can be checked out would most surely increase circulation (efficiency measure) but its impact upon library effectiveness would be open to debate.

Of the two sets of performance measures - efficiency and effectiveness - library effectiveness is much more difficult to calibrate and in the eyes of some (88) cannot be quantified. Effectiveness measures are largely diffuse, non-quantitative and will often require political interpretation by skilled administrators (137, p. 36). The performance measures discussed in this study are primarily efficiency measures.

Goals and performance measures thus become the complementary solutions to a single problem - that of keeping an organization on course and its activities finely tuned to its goals. Performance measures provide the continuums on which success in reaching or movement toward these goals may be measured thereby enabling the manager to quantify success. It should also be pointed out that goals at the organizational level tend to be strategic while goals at the managerial level tend to be tactical. A goal statement with a clearly delineated quantitative performance measure is absolutely crucial to the process of evaluating any library's performance.

The problem of establishing meaningful performance measures is not only one of measurement (along what continuums is change to be plotted) but also one of establishing correctly the units of measurement and then monitoring the impact that measurement has on the administrative unit being examined.

Almost without exception libraries have used as both an efficiency and as an effectiveness measure the number of physical pieces circulated from their shelves without a concurrent goal statement. High circulation rates have been understood to mean a high degree of library success in meeting its goals. This figure is then presented to the funding authority as a measure of the agencies success in meeting its library goal of circulating books.

B. The Problem Examined by this Investigation

Choice is both the greatest opportunity and the most difficult problem faced by a library administrator. He must decide how, when, and where to allocate resources. The manager must also decide which of several short/long range goals best fit these allocation choices and then decide which organizational policies are required to support the carrying out of the first two. Finally, the manager must monitor and adjust the entire process as the organization moves toward its goals. In order to do this he requires data which is then turned into information to support the decision making process. Much of this data comes to the manager as raw numbers which must be turned into descriptive or, depending upon the level of sophistication, inferential statistics describing the operation of an administrative unit. The gathering of such descriptive statistical information for the management of academic libraries has for many years been a local ad hoc effort lacking in definition, standardization, and imagination as well as adequate means for acquiring, storing, or manipulating the requisite data. Indeed, as one article (127, p. 3120) noted libraries, "...do not now have any parameters that will enable (them) to evaluate the effectiveness of library services, much less changes for better or worse. Beyond intuition, all we have are a few library statistics. Those statistics that are collected are not standardized, nor do we know how to manipulate this data for purposes of informed policy planning, much less for evaluation...." The situation has changed little since this was written in 1972.

The problem of obtaining "adequate" managerial feedback from an operating system and its activity centers is not confined to academic libraries. Wasserman (147) has discussed this problem in the context of the special library while Beasley (138), De Prospo and Altman (85, 145) have attacked the problem in the public library setting. Both groups offer findings which are relevant to academic libraries. The latter point out that the provision of a viable library service entails: (1) planning, (2) the use of measurable objectives, (3) continuing evaluation, and (4) measurement of library activities to determine the degree of success achieved. Furthermore, this process is "...circular, dynamic, and continuous..." (85, p. 14).

As noted earlier, one of the most important activity centers in any library is the Circulation or Loan Desk where traditionally, the most used quantifiable measure of library success has been the number of pieces charged

out. Although this has been challenged (151), no widely accepted surrogate has yet emerged. Morse (62), Herner (43), Maidment (44), and Booz, Allen, and Hamilton (45) have all called attention to the deficiency of management information available for the library decision maker. As Morse (62, p. 141-42) very candidly observes "...neither the computer experts nor the librarian (for different reasons) really know what data would be useful for the librarian to have collected, analyzed, and displayed, so he can make decisions with some knowledge of what the decision implies..." The solution offered by Morse is to use mathematical models as testing grounds for policy.

Introduction of the computer into the library milieu has not alleviated the problem of management information. Instead it has made the problem more complex by allowing the user to create more data without the necessity of developing a rationale to support his decisions. The computer offers great opportunities as well as serious obstacles to the acquisition and manipulation of descriptive statistical information about libraries. Unfortunately, its use in such a role has been neither widespread nor uniformly successful in the library environment.

C. Goals of this Study

This investigation is concerned with the inventory, description, and definition of those in-house statistical variables which are by-products of computer controlled circulation systems (CACS) in academic libraries. Usually these are the same statistical performance measures used by library management for the control and operation of that administrative unit as well as for measuring the success of the library in achieving its broad service goals. This statistical data is used in a variety of ways: to measure library success, in library budget preparation, to establish staffing patterns and work loads, in scheduling product flow, measuring service demands, analyzing traffic movement, and in book purchasing.

The phrase "library circulation statistics" as used here refers to the statistics used in administrative decision making relative to the operation of one library and only in a secondary sense does it apply to the statistics which are reported to funding agencies; to state, regional, or national organizations; or to a professional association for comparative purposes.

This investigation is concerned only with the data which have been acquired from a computer. It includes information about the user, about the demands being placed on the book stock, the operation of the administrative unit discussed earlier, and about the relative success of library policies governing loan periods, overdue notices, fines, reminders, holds, call-ins, and the availability of stock. This is the same type of basic information that would be required from any MIS package proposed for the operation of a loan desk and ultimately for an entire library.

No attempt was made to evaluate any of the variables found or to gauge their success in assisting the decision making processes beyond asking library personnel during the on-site visit for their assessment of the statistical package they presently received from the computer.

Specifically, it is the purpose of this study to:

1. Inventory and describe the quantitative performance measures of an academic library system which originate as a result of the activities at an automated loan desk. What is (are) the basic statistical variable(s) used by automated circulation systems in their present management data cumulations? In addition, the study will review the collection patterns, use and state-of-the-art of such statistics gathering activities in general and look for a consensus among the schools visited.

2. Discover what if any supporting rationale exists for such compilations.

3. Suggest possible future applications in automated circulation operations as well as directions made possible by computer processing such as an MIS package.

4. Point out some of the more sophisticated management functions which can be supported by an MIS as well as techniques which can be used to reduce the administrator's level of uncertainty.

5. Discover the intrinsic nature of the performance data described in Goal 1 above. Is it volatile or stable? Is it time dependent? How does one test its utility? Can it be transferred from one system to another?

D. Methodology and Related Problems of this Study

A variety of academic libraries were chosen for this survey in order to assure a broad spectrum of experience in library automation. Libraries visited ranged from the completely on-line system with user self-service (Northwestern) and in-house computer capability to the wholly batch oriented systems, including libraries that have returned to batch processing from an on-line system (40). Twenty-four libraries were visited. Their backgrounds and operational characteristics are discussed elsewhere in this report. This portion of the report will be devoted to the methodological problems encountered during this investigation. These are especially important to any designer of future library management information systems because they include many of the problems which a designer must deal with in putting together an MIS package.

This report is concerned with what was actually happening/available in each library as of the day this survey was conducted. It includes only those events/reports which the computer is presently capable of producing. This is an important distinction since many circulation data bases have been capturing information which could be used in a variety of ways were the software available to massage it. It was necessary, therefore, that the interviewer distinguish between what the system could now do, what potential it had, and what it could not produce under any circumstances. This distinction is especially important when discussing on-demand reports since a number of respondents interpreted the interview question, "What On-Demand Reports Do You Produce?" to mean potential reports (no software presently exists to

arrange and prepare the data now in the DB) rather than in the interviewers sense of reports which are produced only "on-demand" or at the request of the circulation staff. On-demand as it is used here refers to reports produced only when called for by the library staff.

Statistical parameters were often difficult to define and easily misunderstood. The thorniest problems of this investigation were the semantic difficulties encountered in communicating with respondents. One especially bad example of this was encountered in the use of the updating interval "daily" and in the reporting interval for documents "issued daily". There was usually no indication as to whether this was 7 days a week (it usually was not) or 5 days a week, or less. It was especially disconcerting to the investigator to be told that reports were issued "daily" and then to discover that what the respondent meant was five times in every seven days. Another especially bad example of this problem occurred in the use of "Holds" and their related synonyms. The distinction between "Holds", "Call-Ins", "Recalls", "Saves", and "Items Asked For But Not Availabe", as used by the libraries in this investigation was not always obvious. Some libraries chose to treat these terms in a collective sense as referring to the entire process, while others did not. In a strict sense the difference between these terms lies in the historical sequence in which the events they describe took place. For example, a "Hold" is placed on an item and a "Call-In" or "Recall" is then issued for its return - two distinct processes requiring two distinct series of steps usually performed in tandem. Respondents often lumped these activities together under one or another of the above rubrics. For the purposes of this report the process(es) of retrieving items held by another borrower for a requester will be treated under the collective phrase "Number of Holds Placed".

Another amgiguity in the collection of statistics occurred in the number of "patrons processed". It was seldom clear as to whether this talley refers to the total number of ID's processed or to the number of different ID's processed? The answer was not always apparent to the respondents themselves who were using such information. In addition, there were often ambiguities as to exactly whether a given talley referred to items c/o, to people (bodies), or to discrete I.D. numbers. Again the respondents were often unable to make the distinction for this investigator. Another semantic problem was that of discovering and equating synonymous activities from one library to another. This problem was discussed earlier in connection with "Holds" but it applied equally to charge, check-out, takeout and to discharge, return or takeoffs.

Finally, it was often difficult to discover precisely how an item was counted. Sometimes items were counted as being charged to the Reserve Desk while in other cases items were tallied as though charged from the Reserve Desk. Again the distinction was not always clear either to respondents or to the investigator. In any event, these are the types of problems which require the greatest skill on the part of a system designer and may in the long run defeat the application of a true generic MIS system.

II. FINDINGS

A. Operational Characteristics of the Libraries Surveyed

During the course of this investigation, 24 libraries were visited in person and one library (York University in Toronto) was interviewed by telephone. Because of its incompleteness, the data gathered by telephone was not used. Each of the libraries visited during this survey used the computer as an essential component in the operation and management of its circulation activities. All were either connected to the university computer(s) directly (on-line) or indirectly (batch and quasi-batch). Four systems were found to be operating fully on-line, eleven in batch, and nine were operating in a quasi-batch mode which collected and stored data during the work day. All current data was then sent to the university computer during the evening, usually after the library had closed. All of the quasi-batch terminals had access to limited storage and could, therefore, flag delinquent borrowers or transactions involving an item c/o by one person and desired by another.

Respondents interviewed during this survey fell into the following categories: Library Directors (14), Administrative Assistants and Assistant/Associate Directors (9), Administrative staff in Circulation Departments (18), and staff in charge of Systems Departments (7). Forty-eight interviews were held.

Most of the libraries visited during this survey had been operating their present automated circulation systems for a number of years. The earliest system in continuous operation was begun in 1964, the most recent started operation in 1974. The mode and the median age of the present systems were 1970.

All of the libraries selected for this study possessed both experience with and a currently operating computer managed circulation system. They were chosen on the basis of one or more of the following criteria: recommendations from other librarians who felt these libraries would best satisfy the goals of this investigation, the philosophy of management in that library, published reports in the literature, and conversations with hardware vendors. As a group they were felt to be representative of the academic libraries currently engaged in the automation of circulation activities in the U.S. and Canada (1, 2, 3, 133). They ranged in size from a small private four year college serving a student population of approximately 3,000 to a large state university having a user population in excess of 50,000. The group included a junior college as well as research oriented institutions granting graduate degrees. Nine of the twenty-four institutions visited are members of the Association of Research Libraries (82). For a list of the institutions included in this survey see Appendix B.

Both public and privately supported institutions were included with annual operating budgets ranging from $743,639 to slightly over five million dollars for FY 73/74. Holdings capable of automated circulation ranged from a modest 156,383 to over three million volumes. Twenty libraries were in schools where the semester system or a variation of it was used. The remaining four schoold all used a quarter system.

There was a decided preference among these libraries for the Library of Congress classification scheme. Twenty libraries used it either for all or part of their collections. Ten libraries were found to be using Dewey and three had adopted still another classification schedule usually for a collection of special materials. It is also worth pointing out that nine schools used more than one classification scheme for their collections and that with one exception (a classification scheme) all schemes passed through the computer.

Use of a number or letter/number combination in an "accession number" for the purpose of uniquely identifying a physical piece was common with 17 out of the 24 libraries following this practice. It was not always clear, however, whether the "accession number" was considered by the respondents to be essential to computer processing or not. In some cases it was not, while in others its use was either essential or ambiguous.

Also surprising was the minimal importance given to a transaction number as a device to uniquely identify each transaction. Eighteen libraries did not use such a device while five did. One library was unable to supply this information. Such a device is an essential part of computer processing, to this author at least, since it is always necessary that some simple identification be found which uniquely tags each charge transaction. In some cases this was the call number on the piece while in others it was a combination of the borrower ID number with the call number.

Reserve loans were as a rule not handled by the computer. Fourteen libraries reported that all of their reserve circulation was manual, while six libraries reported that all of their reserve circulation was handled by the computer. Four libraries used the computer to manage the longer reserve periods, i.e. 3, 4, or 7 day intervals while manually checking out the shorter loans.

Reserve loan periods ranged from 1 hour to 7 days in length.* The preference was overwhelmingly (22 out of 24 libraries not counting Ohio State for which no information was available) for a 2 hour reserve loan period. Libraries used between two and five different reserve loan periods. The median and mode were both 3 reserve loan periods. See Table 5 for a comparison of library preferences for reserve and regular loan periods.

Regular loan periods ranged in length from overnight or 1 day to twelve months with four libraries using an indefinite period. The most prevalent were the two week (15 libraries), and seven day (12 libraries), with the 28 day interval and the school term both in use by ten libraries. Every library, with a single exception, had more than one loan period with which to check out material. It should be noted, however, that this library had a built-in capacity to expand the number of loan periods should it wish to do so. Loan periods (not counting reserve) in use by individual libraries ranged from one to six with a median of 3 and a mode of 3. These loan periods corresponded well with those listed in Circulation Policies of Academic Libraries in the United States, 1968 (100, p. 23). The libraries visited during this investigation were using 20 of the 27 loan periods listed in this ALA Handbook.

---

* One library with a number of Dept. libraries reported that reserve loan periods were set by the Depts. and not under control of the librarian.

In 1973 Gherman et al. (149) studied faculty loan regulations in ARL academic libraries with some interesting findings. These should be compared with the more inclusive (covers all users not just faculty) loan regulations noted in this report. Gherman and his associates found five loan periods in use by faculty as follows: one month or less - 13, one semester or comparable time - 27, six months - 5, one year (academic or calendar) - 22, and indefinite - 10.

Finally, it is worth pointing out that all libraries with one exception continued to collect some statistics manually from their circulation activities even though they were using the computer successfully to collect others. Clearly there was a feeling on the part of some respondents that, for whatever reason, they must continue to compile at least part of their management statistics manually. The reasons for this were not apparent from the investigation. There was no apprehension or indication from the respondents that computer generated statistics were not accurate or could not be trusted. A more logical explanation is that there are some processes which do not lend themselves easily to computer processing and that these will have to be monitored manually.

B. Findings Directly Related to the Research Goals of this Study

This section is devoted to those quantitative performance measures currently in use by the libraries surveyed. The findings narrated below should be studied in conjunction with Table 1 where the quantitative variables (performance measures) currently derived by academic libraries from their CACS are listed. The identification and description of these parameters constitutes the major thrust of this investigation.

Each of the statistical variables reported here was used in one or more libraries. There were some differences and innovations but for the most part these tended to be variations on a theme rather than radical departures from historically accepted performance measures. For this reason it has been especially difficult to group them into any kind of consensus. The author sought, therefore, to identify and discuss both the major themes as well as the individual variations in the collection of circulation statistics. Semantic difficulties were especially troublesome in the collection of this data. A more extended discussion of methodologic problems was given earlier in this report under the section on "Methodology".

1. All of the libraries surveyed counted the number of items (physical pieces) as they were checked out (c/o). This was a universally accepted performance measure which was then noted in most of the annual reports as a reflection of library activity/use. The statistic itself varied, however, from a straightforward count of all the items c/o during a given time period to the more complex/defined tabulations which counted charges under such variables as the loan period assigned to the item; the status of the user; the type of material (book, journal, serial, thesis, government document, curriculum materials, phono records, instructional materials, framed prints, or unclassed materials); call number blocks; items c/o to a special location inside the library (carrel, Reserve, Bindery, Cataloging, a seminar room,

storage area, or the Reference Department); or by items charged through a designated terminal. Occasionally, these variables were cross-tabulated. For example, the number of c/o for each type (status) of borrower was sometimes cross-tabulated against the type (loan period assigned) of transaction.

2. With the exception of three libraries, all counted items returned. This practice is not common among manual circulation systems and is a statistic which has emerged as a consequence of computer controlled circulation systems. Three libraries analyzed this statistic in even more detail by separating returns for each type of user to show both absolute and percentage figures for borrower by status groups.

3. Eight of the twenty-four libraries questioned chose not to treat renewals as a separate statistical category. Instead these libraries either lumped renewal transactions with charges, or did not allow a renewal per se but required instead that all requests for renewals be handled as returns and c/o again. An interesting variation was discovered in one library which did not count renewals as a separate category but chose instead to count as a separate category the number of charges made to the same borrower within 30 seconds of an item's return, in effect a renewal. Under this system a charge followed by a charge is not considered to be an error as it was in other systems. A return followed by a return, however, was an error in this system.

Interest in the type of borrower carried into the renewal transactions. Three libraries counted renewals in such a way as to show the type (status) of the borrower. One library divided renewals by Dewey class showing for each the number of renewals received in that class.

4. Counting c/o by the category (length) of loan period was not a widespread practice among the libraries surveyed even though these libraries used a variety of loan periods. Ten libraries arranged their statistics to show the number of loans made for each category of loan period. Fourteen did not. This was both a matter of conscious preference with some libraries deliberately choosing not to report such statistics and a consequence of the way in which the loan system itself worked. For example, in three libraries the loan periods available were limited to either one or two, or were a function of the status of the borrower such that a count of loans made to one class of borrower was synonymous with, for example, the number of semester loans made.

5. Interest in the status of the user was widespread among the libraries surveyed. Essentially this represents a concern for who is using the library and is based upon the twin assumptions that different classes of users will make different demands and that these demands (tasks performed in the library) tend to be homogeneous within a given class of user population (79, p. 230), but are not homogeneous from user class to user class (112, p. 407) "...with respect to their reasons for coming to the library, nor in the library materials which they used...." This interest was also a product of the belief that "...conclusions drawn about characteristics of user groups from recorded circulation data have a significant degree of reliability..." (102, p. 301).

A count of library charges arranged by user status was made by all except two of the schools surveyed. Indeed, information on the status of the user was felt to be of such value by some schools that it was further cross-tabulated to show items borrowed for each user type arranged by classification schedule, by the location from which the item had circulated, or by the format of the material taken. User type was also shown for items returned, recalled, renewed, overdue, fined, and for divisional/departmental libraries.

6. Counting items c/o by the format of the material was not a common practice. Six schools reported that they felt this information to be of such value that it was worth capturing and displaying. Of these, however, half reported that they identified and counted separately only selected (one or two) classes of material such as serials including journals, theses, or phono records. Interestingly enough, one library reported that only one type (monographs) of material circulated.

7. Collecting statistical data on the number of items c/o within a call number block or some other subject grouping was widely accepted with 18 out of 24 libraries using some variation of this practice. The parameter most often seen was that of call number blocks either Dewey (three digits) or the Library of Congress using combination of letters and book numbers. There were also examples of the use of very broad subject categories such as the number of items c/o in Science, Education, Humanities, and Social Studies, while some reports were arranged under such topical headings as may be found in the classification schedules. One school chose to rank LC class divisions by the amount of activity (number of c/o) seen in each division. Another library combined the very broad topical headings with a count by the type of material used in that category. One on-line system was designed to show the number of pieces available in a class compared with the number c/o, plus the number of items asked for but not available. Shown for each category in this library were both a percent and an absolute count.

8. It was a common practice to note on the statistical reports the number of items which had been c/o to a special location inside the library. These were usually arranged by the name of an administrative unit or by the name of the geographical/physical location. For example, tallies of items were shown on the reports as the number c/o to reserve, to the bindery, to storage, seminar rooms, the browsing area, Acquisitions, Reference, Cataloging, Mending, carrells, and display cases. Occasionally, locations were listed in another building such as c/o to an undergraduate library. In any event, care was taken to show either where an item could be found or the fact that it was c/o to an individual with the individual identified by an ID number. In only three cases did the name of an individual appear on a circulation report as the present holder of an item and in every case these lists were not available to the public. Twenty-one out of the twenty-four libraries followed the practice of identifying the location to which an item had been assigned. Of these twenty-one libraries three chose a broad generic heading which was not easily identifiable such as "Department within Library", "Internal Library Use", or "Internal Charges", and one chose to assign each special location an ID number.

9. Although it was a common practice to tally on statistical reports the number of items by the location to which they had been c/o, libraries were almost evenly divided between those who identified the place from which an item had circulated and those who did not. Twelve of the libraries examined chose not to identify or count traffic as being from a given location or through a specified terminal even though this activity center was often outside the main building.

An interesting variation was observed in one school which elected to count the return traffic (discharges) made through each terminal, but counted c/o as an aggregate for all terminals. Another library counted terminal traffic in two hour blocks during the work day for each terminal. This latter parameter is significant if one wishes to monitor work loads at activity centers in the system. It was with some surprise, therefore, that its marginal importance was noted.

10. Eighteen libraries counted their overdues either as notices prepared, or items, or both. There were many variations in the way this count was taken with libraries counting overdues by type (1st, 2nd, 3rd, > 6 mos, final, and bill), by the status of the borrower, as a sum of the overdue charges in dollars, and as the number of notices prepared using either one or several items per notice.

11. Libraries were almost equally divided between those which counted lost items (13 libraries) and those which did not (11 libraries). Lost refers here both to items which were unlocatable in the library as well as to items reported lost by the persons to whom they were charged. Lost items were counted either by the status of the borrower, by the dollar value attached to the items lost, or by the lost items which had been returned.

12. Libraries counting items which had incurred fines, or bills, or both exhibited a lack of uniformity in their treatment of the variable which was to be counted. Some libraries counted items, some counted notices which were issued with one item per notice as well as with several items per notice. Other libraries counted borrowers who held items meeting one or all of the above conditions. Because of the variations and the combinations of practices adopted by several libraries, this narrative will discuss only the more general trends. Eleven libraries were identified which had adopted one or more of the variations listed above. The subject of this count varied from the number of notices printed on a given day, to the number of items which have merged into this class since the last report, to the number of bills mailed, and/or notices printed for different users. Thirteen libraries did not consider either fines or bills important enough to count.

13. A count of the items withdrawn from the collection was not common with only four out of twenty-four libraries following such a practice. One library indicated its intention to begin taking such a count soon and another reported that a count was not taken but that it was possible to produce a list of items withdrawn using the computer.

14. One of the more interesting uses made of the data generated by the circulation systems reviewed here was in the preparation of frequency distributions. These were used to show the range of per item uses (number of items

borrowed for each frequency of c/o, i.e. how many items were borrowed once, twice,...n times during a given period) and the range of per person uses (the number of library items, one through n, charged out by a given number of people). The latter is an effective device for locating borrowers who abuse the system by taking an excessive number of items and was used in this way by one major university. It is worth noting that the two variables in each of these distributions were inversely proportional. This was not a widespread statistic with only seven of the twenty-four libraries using it as a management tool.

15. The number of operational errors produced by a computer system is a valuable diagnostic in analyzing the operation of that system and can indicate a deficiency in operator training, problems with hardware, system design, and/or input. Ten of the libraries made no count of the errors produced by their CACS. Four of these did, however, list such errors without counting them. Fourteen libraries counted errors by the type of error made, i.e. transmission errors, invalid input, system rejects, or non-matched record. One library counted errors as a percentage of total transmissions.

16. It is often useful for managers to know what periods during the day, week, month, or school term were busiest. Eight libraries were found which prepared such a statistic for every 24-hour period or portion thereof. These varied from libraries which showed a transaction count for every one (sometimes two) hour block during the work day to those using a daily transaction count. One automated library visited during this survey obtained the count of its daily transactions manually.

17. Libraries tallied requests for items wanted by one user but not to another borrower in a variety of ways. These were referred to on library statistical reports as "Holds Processed", "Recalls", "Reserves Requested", "Reserves in System", "Book Availables", "Saves", "Call-Ins", "Availables", and "Holds". Although these terms were often used interchangeably, they did not always refer to quite the same activity. Indeed, their use and meaning in statistical reports were often ambiguous. Some libraries chose to use one term to refer to the entire process, while other libraries used several terms. "Holds" usually referred to those items which are to be stopped as they return to the shelf. "Call-In" refers to the requests made to have an item returned from its present holder. A book may, therefore, have several "holds" but only one "call-in". It was the usual practice to measure the work involved in this activity by tallying one, several, or all of the steps as a surrogate statistic for the entire process. For example, some libraries counted the number of individuals initiating requests, others the number of items requested. Some counted the number of items called-in, some the number of people notified that they had an item wanted by another person, and some libraries counted the items asked for but not available. Although it was not always clear whether these referred to one step or to the entire process of obtaining a book checked out to one user for another user, they will be treated collectively here under the generic heading "Placing of Holds". Sixteen libraries were found which kept a talley for some part or all of this process. Interesting variations included a count of the holds placed as a percentage of the number of items available for the same call number, and the number of holds placed cross-tabulated against the library (main or branches), and the type of borrower.

18. Only a handful of libraries had formally attempted to articulate a rationale for the collection, use, and organization of their management statistics. This is a commonplace deficiency and has been noted by Evans, Borko, and Ferguson in their "Review of Criteria used to Measure Library Effectiveness". They (99, p. 103) reported that the most surprising, "...aspect of the literature review was the lack of concern with the how and why of the evaluation process..." in establishing performance measures for library systems.

19. The cycles at which statistical reports were produced by the computer, not necessarily the reporting period, are varied and did not always correspond with the cycles at which the file was updated. This poses serious problems for the use, acceptance and creditability of any statistical report. Nevertheless, it was found to be a regular occurrence for all but the "daily" reporting cycles and was not confined to batch mode systems. For a list of reporting cycles, see Table 3.

Reports were issued as both cumulations of earlier reports and as summary reports lacking the detail of earlier reports. The user, however, had little control over the amount of data which he could summon from the computer. The nature of the report (summary or detailed) was contingent upon the time when a given report came due and on the original system design. In no case could an administrator request an ad hoc summary of the information found in one or more reports outside the normal reporting cycles of activity already set into the system. He either accepted a report and tried to answer his needs from the mass of detail before him or he waited until the cycle had ended and the report for the complete period was given to him. Users were unable to change report formats, data cumulations, and report periods at will without major reprogramming. A few reports did show month-to-date and year-to-date cumulations giving some flexibility but the manager did not have the option of tailoring his reports to fit his needs as the needs arose.

Daily cycles were not always the seven days a week usually associated with this term. "Daily" was found to be associated with processing cycles which included 4, 5, 6, or 7 times during the work week, usually once within a 24-hour period. "Daily" was, however, the most commonly used reporting period with nineteen libraries stating that they generated a "daily" statistical report.

The second most commonly used reporting cycle was that for reports which were prepared "on-demand". There were 18 libraries reporting the use of such cycles. On-demand was used by respondents in two ways. One includes those reporting cycles which are unanticipated, irregular, and occur "as the need arises", in a spontaneous, single call for information producing a computer run and its report(s). This was not a common practice since it usually entailed some program writing to create the requested document. The second type of report which came "on-demand" were those produced at predictable intervals but requiring some type of action on the part of the requestor such as the preparation of a "control" card showing the parameters of the desired report. Such reports were produced only at the request of the user, i.e. on demand.

Monthly summaries were next in frequency of occurrence with fifteen libraries indicating use of such a reporting cycle. Other reporting intervals used by libraries and their frequency of occurrence were as follows: annual (either academic, fiscal, calendar, or some combination of these) reporting cycles were found in eleven libraries, seven libraries used as a reporting cycle the school term, a weekly cycle was used by seven libraries, a month-to-date cycle by five libraries, a six-month cycle by three libraries, a cycle of three times a week by two libraries, and the remaining cycles (year-to-date, and twice a week) were each used by a single library. One library was found which summarized its daily computer statistics by hand into monthly, annual, and quarterly reports.

The number of reporting cycles used by a single library ranged from one to seven. The median and mode were four.

20. It was not a common practice to display in the heading of a statistical report the beginning and ending dates for the period to be covered. The report usually bore in its heading the word "Daily", "Semester", "Quarter", "Annual", or some other term thought to reflect the period covered but which was in effect ambiguous.

The reports themselves tended to cover time periods as prescribed by the academic calendar (school year or term) or a predefined portion thereof such as a day, a week, or a month. There was some interest in cumulating or displaying data covering a period other than the prescribed time frames. Managers require the ability to set in their own time frames at the moment a request for information is made. These will often be outside the regular prescribed time frames of a week, month, or school term and may include such irregular periods as the last 13 days, or the first four days of a month or quarter, the first hours of a day or of six consecutive days.

Cumulations of data were made within the conventional time frames of month-to-date and year-to-date.

21. Two on-line libraries reported that they were able to display on a CRT screen the number of today's charges as of the moment when the request was made. One of these could also show the number of returns, renewals, holds placed, and queries made. It was also possible to show the books charged to a patron using the ID of that patron at this school.

22. The size of the library and/or the sophistication of the in-house hardware bore no relation to the sophistication of the statistical package generated by the CACS. Indeed, some of the smaller libraries had the more sophisticated statistical packages while other libraries with access to very large and sophisticated support hardware produced very limited management statistical packages.

23. During the course of this investigation a number of miscellaneous variables surfaced. These were developed in an attempt to sharpen the "in-house" tools library management had at its disposal and were usually prepared "on-demand" by the library to answer special needs. They are included here for informational purposes only and their numbers should not be used in a comparative sense with the other libraries surveyed.

a. Twelve libraries regarded their ILL traffic and their loans to other members of a consortia as important enough to count separately. These usually included the name of the borrowing school with the number of loans made to it.

b. Four libraries prepared annual listings arranged by classification schedule to show the number of items owned by the library for that part of the schedule. Such information had a variety of uses and no two libraries reported the same use of this data. Examples of the uses made of such information reported by the respondents were as follows: as a physical inventory of holdings, to compare holdings with the number of charges from a given section, and to compare holdings with the number of "saves" from a given section.

c. Three libraries reported capturing a daily count of the number of queries made from a library terminal.

d. Three libraries reported circulation use as a function of an individuals major (department or college) by displaying the number of items c/o to individuals registered in one or the other. This was crosstabulated in one school with the degree toward which an individual was working and his year in school. Another school reported that its preparation of this statistic has been discontinued.

e. It is often useful in computer processing to know the total size of the file to be stored in machine readable form (items out) as of a given day. Three libraries did not collect such information. The remainder acquired this statistic in a variety of ways. One prepared a count by LC class, another by status of the borrower, but most prepared a tally showing the total number of items out as of a given day.

24. In addition to the more common statistics listed above collected by several libraries, there were many examples of statistical information collected by only one or two libraries. The following statistical variables were used by less than three libraries, most often their use was limited to a single library:

a. The number of charges made arranged by the language of the item.

b. The use made of items in a browsing collection showing the number of users and the number of days kept out.

c. The number of borrower lists, final notices, holds requested but not placed, tracers placed for lost books, tracers located and not located, cancelled call-ins, second call-ins, pick-ups, borrower lists, attempts to renew a book more than the allowed number of times, and the number of items deleted from the file.

d. The number of borrowers not directly affiliated with the school and their charges.

e. Analyzes overdue reserve by the number of days overdue and the time required to return a book after a recall notice has been sent for each user type.

f. Percent and absolute number of borrowers in each status category with the percent and absolute number of items borrowed, holds, and overdues with holds for each status of user.

g. A table showing how long items had been kept out for each loan period.

h. A count of the number of items loaned and returned on the same day.

i. Two schools reported making a count of the patrons which had been registered at a terminal (CRT) by the Circulation staff.

j. One library reported making a count of the number of items placed on order by Circulation staff.

k. One library reported counting books out to readers leaving the campus.

25. Few libraries took the raw data produced from their CACS and attempted to plot percentages, graph changes, or compare actual with potential users of the library. One school plotted actual against potential users in a histogram, three schools calculated percentages, and one school prepared graphs to show the changes over time of one parameter - the return of 7 day periodicals.

The most significant aspects of statistic gathering are the eventual uses to which such information will be put and the importance which administrators attach to them. Some insight into both questions was gained during interviews with respondents in each school. A review of the replies to questions 2 and 3 on the interview check sheet (see Appendix A) follows. A summary of these findings accompanies this report in Tables 2a and 2b.

Response to the question "How satisfied are you with the statistical management data you collect from your automated circulation system?" was varied. There was a general feeling among respondents that the CACS and the statistics they produce are in need of improvement. During the interview each respondent was asked to note that phrase (of the 5 given) which best characterized his reaction to the above question. Slightly less than half (44%) felt their "System Works but Needs Improvement". The second most prevalent reaction noted was that of "Well Satisfied" exhibited by 29% of the respondents. 15% were "Completely Satisfied", and 2% were "Completely Dissatisfied".

Replies to this question were also tabulated according to the status or position of the respondent in each library. These findings may be seen in Table 2b. Replies from Library Directors exhibited no strong preferences with 36% of the respondents (Directors only) indicating that they were "well satisfied" and 30% indicating that they felt improvements should be made. Two Library Directors (14% of the respondents) were completely satisfied while none indicated that they were completely dissatisfied with the statistical management data they were currently receiving.

Replies from department heads or other supervisory personnel in the Circulation Departments were more evenly distributed with the highest number

(33%) of the responses indicating a felt need for improvement. One circulation supervisor (5% of the replies) was completely dissatisfied with the management statistics currently received.

Replies from Assistant/Associate Directors (including one administrative assistant) exhibited less variation with a simple plurality (56%) of the respondents indicating that their management data systems worked but needed improvement. The remainder of the respondents (44%) at this level were "well satisfied" with the present management data systems, a response not anticipated by this investigator.

Librarians and others responsible for systems work within their respective libraries were even more emphatic in their wish to have the management data system improved. More than 70% of the respondents (71%) in this category characterized their reaction to the present management data statistics package derived from the CACS as, "Working but in need of improvement" a reaction not entirely unexpected from this group.

Question three on the interview check sheet asked the respondent to "Name Some Specific Uses Which You Make of the Statistical Management Data Produced by Your CACS." This proved to be one of the more difficult questions respondents were asked to answer. With three or four exceptions the answers consisted of the traditional purposes seen in the literature. In addition, most respondents seemed unable to articulate more than a few uses for this information and one Library Director candidly admitted that he was presently making no use of this data. Indeed, other than a few exceptions there was a general lack of awareness toward the management potential contained in the existing data collection systems. This is not to say that respondents were insensitive to the potential, rather that they felt a need for guidance.

The answers as indicated were the traditional ones of, "To use in the annual report to show work load," "For guidance in setting hours of opening," "To study circulation by type of borrower," "To study areas of heavy use," "To determine items for storage," "To determine the volume and type of business," "To compare with previous years activities," "To reconcile dollars in the cash box," "To defend budget requests," and "To rationalize the installation of expensive exit control equipment," were a few of the more common replies received.

Although these reactions did appear to be random, there were certain themes which ran consistently through all replies. These closely paraileled those already noted by Burns (55) and were as follows: to discover the demographic characteristics of a user population, to rationalize collection development by determining what is being used and by whom, for internal management of both the circulation operation and the library itself in the setting of staffing patterns or in budget preparation, and finally to provide support for the development of library policy. For example, to rationalize the setting of loan periods and who shall be subject to fines. Two replies which occurred more than once were, "To keep track of overdues", and "To determine which items needed to have duplicate copies purchased".

It is worth pointing out here that significant studies have been conducted and decisions made using automated circulation records in at least five cases in four of the schools studied. One case involved the placement

of an East-Asian collection. Here the study of circulation records enabled the Library Director to successfully remove the collection from its branch status and incorporate it into the main collection by showing quite clearly that many people from outside the Department also used this collection.

The second study also involved the use of a Departmental library and again sought to answer the question, "Is a subject collection located in a branch closest to its prime user population and in the best interests of the entire user community?" The findings of this second study were the exact opposite of those described earlier. In this University the creation of a separate Branch Library (in this case Mathematics) was considered a benefit to the Mathematics Faculty without seriously inconveniencing faculty from other Departments who needed math materials. It is worth noting too that the findings of the second study were somewhat less conclusive on the question whether or not a mathematics collection should be incorporated into a proposed Science Library and on the role played by student borrowers, except to note that as a group students accounted for over 80% of borrowing and faculty for less than 20%.

The third case involves the movement of Business and Social Science materials in H-HJ and HM-HX out of a main library reserve room to a Department collection on the grounds that "no one else uses these materials". The findings proved conclusively that this was not so. There was a much broader spectrum of user population than had been anticipated. As a result, the collection was left in the main library.

The fourth case involves a Physics Library in which the loan period was reduced in order to test the premise that such action would increase the availability of high use items. A twenty percent increase in student circulation was felt to bear out this assumption.

Another example of a library using computer generated information to manage its collections for the best use of all surfaced at one school through a computer analysis of borrowers. This was in the form of a frequency distribution arranged to show the number of items taken per borrower with borrowers grouped into the number which had taken one, two, three,...n items. From this table the library was able to determine that one borrower had taken more than one hundred items in a single quarter - a fact easily discovered by the computer.

C. General Findings and Observations Relating to Automated Circulation Systems in the Libraries Surveyed.

1. Essential to the smooth functioning of a loan desk is the knowledge of where an item not in its accustomed place may be found. All off-line libraries surveyed prepared such a "hard copy" listing arranged by call number. Sometimes these lists were first arranged by the type of material (all periodicals, theses, prints, records, or government documents grouped together) or with different call numbers (LC or Dewey) placed together. One library included on their list items which had been placed on order as well as those which had been lost and billed. These lists appeared "daily", i.e. from one

to seven times a week in hard copy with several libraries producing a second or third copy on fiche. One library prepared an abbreviated list of items c/o for users showing only the call number, author, title, and special locations with a more detailed listing for library staff members including all of the above plus the book number, library code, SSN with patron name, when the item was c/o, when due to return, status of the borrower, and the number of overdue notices sent thus far.

2. Conversion of the collection to machine readable form was performed both as an item circulated, usually between the charge out and return transactions, and from the shelf list with a slight preference for the former.

3. Only one library was found which allowed the user to charge out material on a self-service basis although there are reports (54) in the literature of others planning to follow suite.

4. Two libraries were found which were handling all reserve functions with a batch mode computer system.

5. Libraries are handling large numbers of transactions through their terminals on a daily basis with comparative ease. The word transaction as used here includes charges, returns, renewals, fines, queries or any traffic between a computer and a library terminal. Estimated peak daily traffic loads ranged from a high of 22,000 (a composite figure for all terminals in one library) to a low of 1,000 transactions. Low daily traffic loads ranged from a high of 9,000 to the smallest low day reported in any library of those surveyed - 25 transactions. The median among the high traffic days reported by libraries was in the 3,000 transaction/day range while the mode was in the 1,000 transaction/day range. Median among the low transaction/day was reported in the 400 range. The mode for low traffic days was in the 200 transaction/day range.*

6. Physical format was not found to be a deterrent to an item's passage through a CACS. Libraries passed through their automated circulation systems items in a wide variety of formats. Library owned items circulated by one or more libraries included the following physical formats: codex, theses, government documents, serials, periodicals, curriculum guides, instructional materials, films, audiovisual items of all types, framed prints, phono records, microforms, newspapers, maps, unbound journals, and magnetic tapes. Most prevalent was the codex or monograph which was accepted by every automated circulation system.

7. Libraries which do not operate in an on-line mode face the recurring problem of up-dating their data base in such a way that the information available to the library user is as current as possible. Because of the very volative nature of data acquired by a circulation system, the ideal is to update the file continuously. Four libraries were on-line and able to do this. Of the remaining libraries, ten were updating their master files five times in the seven-day period from Monday through Sunday. This was usually accomplished during a Monday through Friday evening cycle, but examples were

---

* These figures were those reported during the interview by library respondents and should be taken as estimates only.

found of Sunday through Thursday and Monday through Thursday with Saturday or Sunday updating. Four libraries were found which updated every night (seven days a week), two which updated the file four times and six times a week respectively, one library which carried transaction cards to the computer center eleven times in each seven day period and another which reported updating its circulation file once every three days. One library reported that it normally tried four times a week to update the circulation file but that it was "often" bumped out of the processing que. Another reported changing update cycles during the summer from its usual five days a week to three.

8. In answer to the question, "Are all circulating items in machine readable form?" libraries were almost evenly divided between those which had completed preparation of their entire circulating collection - thirteen libraries - and those which were still converting their collections, other than new acquisitions, to machine readable form. One library reported that conversion was complete except for branches not in the system, two reported they had only 40% and 45% of their conversion completed since beginning in 1971, while several with large LC holdings reported some Dewey numbers still not converted.

9. Libraries transmitted information about the items to be circulated to the computer in a variety of ways. Most common was the traditional 80 column tab card used in 20 libraries. Other techniques included the use of zebra labels and light pens - two libraries, use of a main entry catalog card which was duplicated and then input manually through a CRT - one library, and one library in which an operator entered charge out information directly from the items to the terminal without ID or book card.

The 80-column book card contained a variety of information. This information and its appearance on these cards is as follows: Call number - 20 libraries, author information - 14 libraries, title - 15 libraries, machine codes designating the loan period of item - 6 libraries, the year of publication - one, accession codes - nine, a location code for the library owner - nine, a type of material code - three, a form of material code - one, and various other miscellaneous codes - two.

10. Four libraries were found in which the CACS produced a slip identifying the piece that had been c/o and its due date. This was placed with the book and used by the borrower to leave the building.

11. One of the benefits to be realized from a CACS is the production "on demand" of lists of items created to answer special and/or required library needs. Many of these are exclusively by-products of an automated system and would have been impossible to produce without a computer. Each circulation system had its own well developed hierarchy of reports describing the operation of that system. There was, however, a remarkable similarity seen in these reports from system to system such that many represented merely variations of analogous reports produced by other systems.

12. One major library pointed out to this investigator that it was phasing out its in-house systems staff and that further automation would be accomplished by means of an outside firm working on contract. This included the maintenance of systems now operating.

13. As a general rule the titles of circulation system reports offered few clues as to what the report contained, how it was formatted, the period covered by the information, what the variables were, or their meaning.

14. In addition to the more commonly prepared computer reports mentioned earlier, there were a number of interesting variations unearthed during this survey. These will be described below:

Lists prepared by less than three schools*

a. At the end of each term a list of students which have overdue items. The computer prints on this listing the name of the student, the titles, and the classes of that student. A library assistant then visits that class during the final exam to ask for return of the books.

b. A list of all books charged out from limited access storage.

c. All holds which have been cancelled.

d. List of the entire "hold" file as of the date of request.

e. A list of items to search which have been overdue more than 10 days.

f. A list of Discharges with "Holds" still on them.

g. A list of missing items that were subsequently taken by another borrower.

h. Missing books which have now returned.

i. Books with a third overdue which have now returned.

15. All libraries visited either had in-house or at their disposal a large amount of computer power. Three libraries had direct in-house access to PDP 11 computers, one library used a PDP 8, two libraries had System Sevens, and one used a Honeywell 316 Mini-computer. In all libraries except one these were supported by background computers in the 360/370 range on which nightly processing runs were made. As noted earlier there were several quasi-batch systems which collected data in a batch mode for "daily" update while at the same time using a small memory to flag needed items and delinquent borrowers.

The terminals by which data was captured were another matter, however. Four libraries reported that they were still using first generation data capture equipment (IBM 357), eight libraries were using IBM 1030, four were using C-Deks, and six were using teletype terminals. At the other end of the scale nine libraries were using CRT's and two reported they were using light pens for data capture. See Table 4 for a list of hardware presently used by the libraries surveyed.

---

* These descriptions are by function of the list and not by its title.

It is interesting to compare this with the national trend reported by Foil (86, p. 29). She found the three most commonly used circulation systems were the IBM 357, the Mohawk Data Sciences C-Dek, and the IBM 1030. She reports these as "...accounting for almost 75% of the applications...while five other systems make up the remaining 25% of the applications.

16. Respondents often pointed out to this investigator that they possessed the capability for collecting data about a given variable but had chosen not to, or that they had collected such data in the past and were no longer able to continue, or that they intended to begin collecting such data within the next few months but had so far been unable to muster the necessary resources. This served to strongly underline for the investigator a major issue facing contemporary library management - one which surfaced repeatedly during the course of this study. That is the general unavailability of a multipurpose flexible management data collection system containing current, concise, accurate, and relevant data upon which to base decisions. Yet there presently exists within libraries using the computer a large reservoir of just such information which could be used to sharpen management's judgement in these institutions by an order of magnitude. This unexploited potential is now available within existing data bases (all in machine readable form) which contain the historical information derived from circulation activities over a number of years. Evidence of this weakness was seen repeatedly in the limited number of variables (those actually in use at the time the investigation was conducted) cataloged by this investigation as well as in the relatively trivial ways such data was being handled. Indeed, an unexploited potential lies both in the dearth of variables now used and in the lack of sophisticated manipulation of these variables once they have been identified.

D. General Observations Relating to the Operation of the Libraries Surveyed

1. Six libraries reported that they levied fines against faculty members. One of these had not yet started this practice as of the survey interview but was to initiate its program during the fall of 1975. It is interesting to note that these fines were levied both for late books as well as for failure to return an item requested by another user. Fines as a deterrent, however, are being replaced by an even more effective method - locking all delinquents out of the system - something possible only with a computer managed circulation system. Cf. the ARL report on faculty fines by Gherman (149).

2. Libraries were found which used or were conforming to as many as five operating years. These periods with their reports, constraints, and deadlines were the fiscal (not always July through June), calendar, personnel, school, and annual report year. These were often accompanied by an additional layer of biennial reports with their concommittant planning functions.

3. The Social Insurance Number in Canada and the Social Security Number in the U.S. were the two most common individual identification numbers found. There was a tendency to add to these an extra digit (10th) to designate the status of the owner. This was then used to determine/verify the correct loan period for a given class of user.

4. Loan periods have traditionally been a function of borrower status, type of use (reserve or home), type of material, or a combination of all three, except in those isolated cases where there was only one loan period. In this study loan periods were assigned automatically by the computer or established by the operator at the time a transaction was made on the basis of one or more of the above.

A new approach to the establishing of loan periods is being tried by some schools in the U.S. and Canada. This is the variable loan period in which the length of time an item can be borrowed is a function of the demand being placed upon that item. Such a policy would be impossible without a computer.

5. In-house use continues to be a problem for library administrators attempting to measure demand. Here is an unknown portion of the collection used an unknown number of times by an unknown number of users. Four libraries were found plus the University of Victoria* which counted in-house use as a separate statistic. A major deficiency in this statistic, however, is the fact that it tells one nothing about the user who selected these pieces. For additional discussion on this problem see the section of this report concerned with "The Library Statistic As a Management Tool".

6. One library was found in which a third hold placed on a monograph was automatically refused causing the item to be recalled and placed in the Reserve section.

7. Libraries were found using as many as 20 different types of notices prepared by a computer.

8. One major research library reported that it did not use a borrower ID card.

9. One major research library reported several in-house studies showing that circulating items tend to be kept for as long as the loan period permitted. Such behavior was found to be a consistent pattern with all borrower groups at this school. In addition, the average length of delinquent loans was found to be 4 to 6 days beyond the due date. Faculty had the highest overdue rate of all user groups. The phenomena of keeping books until the expiration date of a loan period is in agreement with the findings of others (118, p. 8 and 119, p. 27) reported in the literature.

10. Only one library reported an attempt to correlate class standing and library use although this capability was reported as one reason for adopting an automated circulation system by another (13) of the schools surveyed. Their conclusion after studying the library activity of first year arts students was that "...in general it seems that those students who attained higher standing were also comparatively heavy library users...." Studies (117, p. 98) reported in the literature concerning the performance of students on library tests both support and conflict with these findings and more work needs to be done in this area.

---

* Not one of the libraries visited during this survey.

III. DEVELOPING TRENDS IN CIRCULATION SERVICE

It is interesting to speculate on what academic libraries will look like and how they will be operated in the next decade. Dwindling resources will act as the major impetus in both developing trends and future research; a fact often alluded to by Baumol and Marcus (146) in their work on the Economics of Academic Libraries. This observer sees no diminution of the economic pressures on all public institutions. Such pressures are going to force more processing efficiencies and much closer control over all operations. Many of the following trends may be seen now in some of the larger libraries. Their practice will spread into the middle and smaller range of libraries as the decade proceeds.

1. A more sophisticated use of statistics to forecast, simulate, and model all phases of library operations especially those of circulation will develop. Such information will sharpen management's ability to control by an order of magnitude and will eventually be required by the funding agencies of all public institutions. This data will be used both to strengthen library decision making and to "document" changes in library policy. It will be facilitated by the spread of on-line and/or minicomputers in libraries.

2. Self-service charging of library materials will become more widespread and will contribute to a reduction in loan desk staff.

3. Either all members of a library's constituency (including faculty) will be fined equally or fines will be eliminated entirely with "sanctions" against all recalcitrant users substituted in their place. Moreover, if a library elects to fine its users such penalties will be invoked only for items wanted by another user, i.e. for holds and recalls. It is worth pointing out here that a 1973 study (149) of ARL member libraries notes fifteen libraries which fined faculty. Three of these reported the penalty as not being enforced.

4. The use of flexible due dates which depend upon an items circulation history will see greater popularity. It will become increasingly difficult to rationalize loan periods for a constituency on the basis of undocumented demand, user's rank or status, type of material, and/or historical (privilege) precedent. Such a flexible policy means that the more loans/recalls are made for an item the shorter will be its loan period and conversely with no demand an item may be kept for an indeterminate period. In the latter case loan periods will become a function of the inventory responsibilities of the library, i.e. how often does the library need to see and/or remind the holder that he has a book. Recall and return regulations will be strictly enforced.

5. Libraries will develop more sophisticated techniques for monitoring in-house use either by means of the computer, or selective sampling techniques, or both.

6. The expansion of computers into the library environment will continue but at a slower pace. This will happen because libraries will be unable to support labor costs which move in only one direction. Labor is now, and will remain, the highest percentage of a library's operating budget.

IV. THE LIBRARY STATISTIC AS A MANAGEMENT TOOL

The library statistic is an anomaly. It is poorly conceived, poorly used, poorly designed, and frequently called upon to answer questions it was not originally intended to supply or to support findings after the conclusions have been made. Like the performance measure discussed earlier it is poorly understood and seldom used correctly. Indeed, as Palmer (84, Abstract) notes, "...librarians have been data-gathering rather than statistics producing..." and he goes on to point out that library statistics "...are more often applied to status and prestige than to any meaningful measure of impact upon the library's clientele..." (84, p. 97). A statistic has no value until it influences, in a rigorous way, a decision either to do or not to do something. Its primary value, therefore, is to management and to the decision making process.

Despite much professional skepticism about library statistics, they have often been mentioned as part of the rationale for implementing library automation and are felt by some (131, p. 25; 151) to be at least partially indicative of library use. To the extent that the use of statistics is accepted by the profession at large, they can provide useful standards and important management tools for the individual administrator.

Library statistics provide the means by which library performance and goal achievement can be measured. They are either descriptive or inferential and allow the library manager to discover magnitude, to compare parameters, and to forecast the quantitative aspects of library service. Statistics have two properties which make them useful. They enable us to describe and compare institutions, their properties, their activities, and their events. Secondly, they enable us to make certain probabilistic inferences about the frequency of these activities, events, and properties, their characteristics and behavior, both present and future, while interpreting them in the light of other factors or correlating their occurrence with similar events in other libraries.

Management techniques are no more than efforts to bring order and purpose to a set of seemingly disorganized, disconnected series of events such that their (events) occurrence may be controlled to some end in the most efficient and effective means possible. Statistics are essential tools in this endeavor and computers have opened up for the library administrator a tremendous potential which has up to now remained largely untapped. This type of thinking has been slow in coming to libraries and as Maidment (44) points out the commercial applications of computers have been much more sensitive to their potential for aiding management decisions than have the library applications.

What then are some of the uses (potential and otherwise) which can be made of statistical information?

1. To establish operational continuums on which management can set performance levels with predictable expectations of success.

2. To monitor performance and discover trends.

3. To lessen and/or measure the degree of uncertainty involved in decision making.

4. To model library operations on paper before their implementation.

5. To develop service and cost indices against which libraries may compare themselves and their performance with other libraries at local, regional, state, national, or international levels.

6. To serve as a mechanism for the analysis of internal activities, progress, growth and their corollary the pursuit of in-house analytical studies for management. Such data will have no real meaning for any other library except to provide a methodological precedent.

7. As a mechanism for reporting change to a funding agency. It is the belief of this observer that the statistics now gathered by each library do not easily mix with those from other institutions for a variety of reasons and that much of our present national difficulties stem from attempts to do so and the consequent problems in standardizing and in the equating of dissimilar things over time.

One of the major impediments to the effective use of statistics has been the debate over qualitative vs. quantitative performance measures. This debate has taken place between those who have refused to acknowledge that there is any relationship between the two or that any qualitative measurement of library services is possible, (87, 88, 114) and those who have sought a balanced perspective in which both are used in a complementary fashion (84, 85, 138, 145, 151, 153).

This author takes the position that statistics provide the means whereby library activities may be better understood, measured, forecast, compared, described, and from these descriptions inferences drawn about the operation of a given library. If statistics are to have meaning, however, they must be placed with other facts at decision points where they provide descriptive links between an organization's goal statement and its day to day operations. The setting of precise numerical objectives is critical to any goal setting exercise as well as to the establishing of a correct balance between qualitative and quantitative performance measures.

Another obstacle to the effective use of statistics has been the continuing dispute over standards among members of the library profession. Standards are necessary to insure some type of uniformity in comparing libraries. Indeed, without standards libraries cannot be compared. If libraries are to develop and accept a generic MIS model or statistical package capable of being utilized by college and academic libraries then there must be standard methods for the accumulation of statistical data that will be accepted by each library. As Daiute and Gorman (42, p. 256) have pointed out, it is not the "...specific quantitative standards which should be generalized in the library field, but...the methodology of measurement and analysis which can be generalized and standardized...."

A third impediment to the effective use of statistics has been the lack of an adequate understanding of the theory of measurement. For statistics to have meaning they must be supported by an underlying theory of measurement which can supply both the concepts of measurement and a philosophic rationale for the actions we undertake in performing measurement. Many important insights into measurement, its theory and problems, are provided by Schoderbek (150, p. 114-128) in two chapters of his book on management systems. Note especially the chapter written by Churchman. Schoderbek (150, p. 115) maintains that "...since measurement provides information and information provides a logical basis for decision making, the quality of decision making will ultimately be dependent upon the quality of measurement...." Measurement theory in addition to systems theory must, therefore, be integrated into our concepts of measurement. This involves an understanding of such basic ideas as the various scales of measurement-nominal, ordinal, interval, and ratio as well as some basic guidelines as to how measurements are to be made (151, p. 3606).

A further issue which has clouded the use of statistics by the library manager has been in-house use. As noted earlier (Findings - Part D, no. 5), in-house vs. outside use of library materials continues to be a problem for library administrators seeking adequate measures of library performance. Several of the libraries in this study reported that they collected and measured both types of use either as a normal part of their statistical package or on an irregular basis. One of the schools (Pitt.) visited during this investigation reported efforts at correlating the two.

In 1972 Purdue reported in a short study that it had compared the statistics for materials checked-out for home use with those for items used within the library (a comparison of numbers only, not call number blocks) using the Pearson *r* correlation technique. It was found that, "...library use statistics can be predicted based on data collected about home use. It is recommended that the library use statistics be dropped using instead a figure computed from the home use count..." (152, Abstract).

In an early study of in-house use at the M.I.T. Science Library, Bush, Galliher, and Morse (101, p. 93) found that "...for every 8.4 withdrawals during any given period of time, 91.6 other tasks were performed...of these 91.6 other tasks...26.3 constituted book consultations, (and) 45.9 (constituted) periodical consultations..." in the library. They concluded that "...circulation rates alone are therefore an inadequate index of library use...." Most, if not all librarians, would agree on this point. Ford (117, p. 99) in his review of the literature of user studies refers to research in Great Britain at Lancaster and Durham where workers reported that "...a book was likely to be used three to nine times in the library for each time it was borrowed...." It is clear that the quantity of in-house use is significant and cannot be ignored as a library performance measure.

In a U.S. study Morse (62, p. 176) notes that "...books in the Science Library were used in the library 4 times as often as they were borrowed. But of the books consulted in the library, half of them were tables, general references, and books on reserve; therefore, of the books...which could be borrowed, on the average they were used twice in the library for every time

they were borrowed...." Morse goes on to point out that this use ratio "...varied greatly from book to book and from book class to book class... The difference undoubtedly reflects a difference in the way different classes of books are used..." both inside and outside the library. This suggests an entirely different facet of the problem - what portions (subject areas) of the collection are being used inside the library and how do they relate to what is being taken out of the library. McGrath (46) found that in-house use (by LC and Dewey class spans) correlated well with out-of-house use in an open-stack university library while Fussler and Simon (47, p. 115) developed similar findings when they wrote that books which "...develop little recorded use develop little browsing, and books that develop much recorded use develop much browsing...."

This point was carried even further by Buckland and Hindle in an unpublished paper referred to by Leimkuhler and Cooper (48, p. 40). Buckland and Hindle argue that in-house use is biased toward the "...inactive and perhaps less relevant materials...." If this is true, then in-house use will tend to be of the less relevant materials and can, therefore, be discounted as a deterrent to the adoption of recorded circulation (out of library use) as a library performance measure.

V. LITERATURE REVIEW

The quantitative aspect of librarianship has been a recurrent though muted theme throughout librarianship for many years. As early as 1933 Brown and Bousfield (74) noted some of the uses to which circulation statistics could be put while pointing out that "...statistics should be kept for some specific purpose. If statistics are not used or if no practical conclusions can be drawn from them, their compilation is unjustifiable...." Interestingly enough many of the uses for statistics which they suggested - analysis of students reading, allotment of book funds, books lent for home use, books used within the building, loans made from reserve or periodical rooms, books lost, length of time required to deliver books called for, requests not supplied, and statistics on inter-library loans - are the same statistics we are concerned with today. Only in the last ten to fifteen years, however, have statistics become a matter of such crucial importance and then only because of the financial exigencies forced upon libraries by the economy and inflation. As recently as 1961 George Fry and Associates in their Study of Circulation Control Systems pointed out that throughout their "...study no specific example was found where statistical information, other than daily circulation counts by adult and juvenile, and usage by individual book, was actually being productively applied. It was found that most large libraries claim to be operating successfully without more detailed circulation statistics..." (57, p. 22). This lack of quantitative self-knowledge has been a help or a hindrance depending upon ones point of view, but the lack of a quantitative dimension to our professional and institutional lives can no longer be ignored. Indeed, libraries are being called upon to quantify using not only the elementary arithmetic functions of addition, subtraction, multiplication, and division, but also to perform statistical manipulations requiring a familiarity with probability models, measures of central tendency, forecasting, regression, simulation, linear programming, and MIS among others. Fortunately, there is a growing number of librarians who can use these tools. More will be required in future to provide managers/administrators with the information they need to run a large and complex organization such as the contemporary library.

One consequence of this reluctance to quantify has been a lack of knowledge about libraries, information systems, and the mechanisms which make them operate smoothly. This was graphically illustrated in one annual report by a University Librarian visited during the study who noted that, "...like most libraries, we have little in the way of management information which could tell us if we are doing better or worse from year to year..." (Annual Report of the University Librarian for 1973/4, George Washington University, p. 2). Sadly enough this frustration is not atypical and is the reaction of most library administrators today whose professional life is spent making decisions without either the requisite data to make them well, or to measure their validity or future impact upon the operations for which they are responsible.

It is easy to find this theme echoing through the literature and as recently as 1974 Buckland noted that "...The generation of management information from automated circulation systems is a technique that is...sadly neglected..." (33, p. 352). Fortunately, as Buckland goes on to point out a "...surprisingly large amount of quantitative analysis..." is going on in the library profession today.

Much of this current work has its genesis in studies which go back into the sixties when the tempo of research devoted to the more scientifically rigorous aspects of measurement, quantitative performance standards, and operations research in libraries increased markedly paralleling a similar interest in user studies, cost analysis, PPBS, work study, operations research, and systems analysis. One need only look at the number of conferences and workshops (41, 58, 59, 60, 63, 80, 83, 84, 96, 105) held during the sixties and seventies which were devoted to the quantitative aspects of library operations to become aware of the desire by administrators/decision makers throughout the profession for more and improved measuring techniques.

The body of literature covering library performance measures, effectiveness criteria, and quantitative management is large and growing. Meier (136), Wessel et al. (98), De Prospo et al. (145), and Evans et al. (99) provide good introductions to the problems of establishing library performance measures. It is worth noting that this body of literature is closely related to and often overlaps that on costs and on user studies. Ford (117) has prepared an excellent review of user studies which should be read by anyone concerned with performance measures.

Many of the performance measures mentioned in early studies either originate in or derive data from activities which take place in and around a circulation desk. Stangl and Kilgour (102) have studied user characteristics from circulation charge slips in medical libraries. Bell Telephone Laboratories (103) has a variety of management reports produced from their CACS including such items as circulation statistics, titles in demand, reserve queue aging, loans by subject, loans by using Dept., and a zero activity list among others. IBM (104, p. 6) has reported the use of a number of management ratios for "...evaluation or self-audit of the library activity...." Among them are loans vs. acquisitions, loans vs. collection, and loans vs. borrowers. In an exploratory paper Pritchard (142) has proposed a number of management ratios, several of which are based upon circulation data, for use by libraries analogous to those already in use by industry. Orr et al. (110) have compiled a list of performance measures for academic medical libraries while Rzasa and Baker (111) have suggested two measures of effectiveness for university libraries. These measures were later used by Pritchard, Auckland and Castens (126) to establish a measure of overall library effectiveness for the City of London Polytechnic Library service. Wessel et al. (98, Phase III, p. 4) has compiled a list of principles "...upon which library performance, or efficiency or effectiveness might be based...."

Any discussion of the quantitative aspects of library management would be incomplete without some discussion of operations research. The quantitative dimensions of librarianship and information science were noted by operations researchers in the fifties and early sixties. OR trained people were quick to point out the many analogies between the problems facing industrial and library managers. As early as 1954 Morse (101) and his associates on the Institute Committee On Operations Research were studying the Science Library at M.I.T. and by 1962 Morse was applying standard operations research techniques to library problems through team projects in his Operations Research Course. Students were examining such library problems as missing books, in-room use of library materials, the application of queuing theory to library problems, and attempting to model future circulation rates of a book. These studies

were followed by more studies such as those listed in the bibliographies which accompany the articles by Mackenzie and Buckland (61), De Prospo (145), Buckland (33), Beeler et al. (153), and in the bibliography by Slamecka (75). The latter appeared with a report of the conference held at the University of Chicago in 1971 on "Operations Research: Implications for Libraries". An earlier though somewhat dated bibliography by Buckland et al. (81) is also available. In 1974 Stock (95) issued with his book on Foundations and Practice of Library Statistics a long bibliography covering much of the European literature.

Several excellent reviews of the implications for libraries contained in operations research and its tools have been prepared by Elton and Vickery (76); Kraft (96); Mackenzie and Buckland (61); Churchman, Bookstein, and Swanson et al. (41); the Institute for Operational Research (144); Ward (32); and Leimkuhler (77). The first three of these specifically draw attention to the area of circulation and its ancilliary activities.

In a recent paper Bommer (139) has suggested several reasons why OR has not achieved its full potential as an analytical approach for library management and with De Prospo (145) is quite critical of OR. Leimkuhler has also been critical of OR applied to libraries and points to some of the potential misuses. Like Churchman he is "...critical of efforts to measure system performance in purely physical or monetary terms..." (77, p. 6).

Ward's (32) chapter in volume 1 of Studies in Library Management is titles, "The Evaluation of Library Services," and has as its aim "...to provide an account of some of the more promising techniques that have been used to evaluate library services,..." The Institute for Operational Research (144, p. 19), White (106, p. 33f), and later Kraft (96, p. 20) list a number of "...possible library applications of operations research..." techniques to typical OR problems in libraries. All of these relate either directly or indirectly to circulation functions.

Thus we find that it is possible to draw library analogies, as Heinritz (31), and Nussbaum (58) have for seven of the eight operations research problem types noted by Ackoff (30). Nussbaum could not find an analogy in libraries for Ackoff's "competition problem". The difficulties experienced by an individual in attempting to use a card catalog in which he is in competition with all others using the same tool is a somewhat simplistic illustration of the type of problem in which a user makes a decision whose outcome depends in part upon the decisions of others.

The above should serve to illustrate the point that the differences between the analytical techniques required by the library manager and those required by the manager in industry are minor. Such differences are best illustrated in the goals (ends) of industry and not in the problems or analytical techniques used to solve them. A careful examination of the analytical techniques used by the manager in the business world will provide the library manager with many useful insights into his own problems as well as with a powerful arsenal for evaluating the success or non-success of his decisions.

In point of fact, circulation statistics have provided the data for a number of serious studies of library activities. These include models which can be used to purchase additional copies of heavily used materials (62, 66, 68, 69, 70, 78, 122, 135); prediction of use or number of anticipated circulations (62, 67, 73, 148); rules for the relegation of library materials to storage (62, 67, 113, 120); a methodology to establish limited loan periods for heavily used books (7, 62, 116, 122); creation of optimal loan periods for periodicals (65); and the study of user characteristics (70, 71, 72).

The move toward the introduction of quantitative analysis into library operations reached a high point with the recent publication of a paper by Orr (34) on the measuring of library services. This paper presented a "...general framework for considering the relative advantages and disadvantages of different quantitative measures...(focusing) on their use as practical aids in the management of individual libraries...." It should be required reading for all library administrators.

Thus we find a strong and viable movement within the library profession not only to adopt those quantitative analytical techniques already proven by the manager in industry but to develop research methodologies indigenous to the profession itself.

VI. FUTURE RESEARCH NEEDS

Out of this investigation, a number of topics have surfaced which will require more study. These are summarized below.

1. Academic libraries need a definitive manual on the administration, automation, and operational aspects of circulation activities. Such a manual should also contain a standard glossary of circulation terms covering processes, staff functions and statistics. The most recent efforts in this area are those of Brown and Bonsfield (74) issued in 1933 and now very much out-of-date.

2. More work needs to be done in perfecting the techniques for measuring and correlating student performance in school with that individuals use of the library. Are high grade point averages necessarily associated with library competence? What parameters can be derived from a CACS for answering such questions?

3. Ridgway (50) has called attention to the dysfunctional consequences for a staff which can accompany the introduction of quantitative performance measures and goals. Knowledge of the impact which quantification will have upon a library staff, i.e. the introduction of a statistical management package, is crucial to the successful acceptance of the package and even to the operation of the administrative unit itself. Much basic research needs to be done on the impact felt by a library staff at both professional and subprofessional levels following the introduction of quantitative performance measures.

Much of the basic research called for here has already been done for private enterprise in the areas of organizational behavior and the introduction of change. How much of this can be extrapolated to the library as an organization remains to be seen. Nevertheless, it is this author's belief that analogies do exist and that a study of the impact on the organization of quantitative performance measures is best begun from the perspective of management and organizational theory. The work of Argyris (52), together with that of Lawrence and Lorsch (51) will provide useful introductions to the theory of organizational development and change with the concommittant research methodologies. It is in this context and from the broad perspective of organizational development that the problems raised by this research should be pursued.

4. Closely related to the issue of quantitative performance measures is the seeming discrepancy between management's philosophy and the action oriented goals seen in quantitative performance measures. For example, library management has traditionally viewed "service" to the user as its paramount goal. The user here is the collective user, however, and not any particular individual. One measure of the units success in achieving this goal is a high and increasing circulation figure. A low or decreasing total circulation figure is always a matter of concern on the part of top library administrators. Yet this goal is often at variance with the operational rules laid down by the same top management for a fixed length circulation period. A variable length or even in selected cases a shorter circulation period might better meet user needs and at the same time increase circulation

statistics. Thus we find a discrepancy between administrative goals (service to the collective user) with their accompanying performance measure (high circulation figures in annual reports) and the actual operating policies seen in a fixed length circulation period for all materials regardless of type, demand, or use being made of such material.* Such discrepancies will only become more visible and debilitating in the presence of a computer driven statistical management information package. Hopefully, this research would also settle such questions as, "Does an item tend to be kept for the entire loan period?"

5. In addition to those broad areas of research interest suggested earlier the author would also like to propose a number of more circumscribed but equally important questions which continue to plague administrators. Quite often these are problems on which some work has already been done but a definitive effort now needs to be made which will enable the profession to vigorously apply its findings to all types/sizes of academic libraries under a variety of operating conditions.

a. Some technique or techniques which will allow for the monitoring of in-house use are essential to a full understanding of library users and their demands.

b. The relationship between the length of the loan period and the renewal rate needs to be examined. Is the renewal rate affected by the length of the loan period. Some work has already been done in this area. Buckland (122, p. 101) found that the "...length of the official loan period had little effect on the frequency of renewal..." at Lancaster. Can these findings now be extrapolated to other libraries? Under what conditions?

c. Does the population of items in heavy use suggested by Trueswell (107) change or remain constant over time? From library to library? What techniques can be used to easily identify such items?

d. An inclusive list of performance measures should be compiled for all types of libraries. Such a list would provide a basis for further discussion/quantification of library performance measures and a touchstone for the design of new ones.

---

* In fairness to those libraries covered by this survey it should be noted that several were moving in the direction of a variable length circulation period and/or the use of no fixed loan period.

VII. CONCLUSIONS

The potential of the computer for the collection, massage, and production of library management data has not been fully developed. This potential was often and freely acknowledged by respondents during this investigation but it remains, nevertheless, largely unexploited. Computers are changing the ways libraries are managed but not managing the ways libraries are changed. With the exception of a few outstanding examples, there is little sophistication in the collection, manipulation, or use of the statistical management data now being produced by computer automated circulation systems for the support of library planning/operational functions. The use of a computer to efficiently monitor a library's performance continues to be "...one of the most significant potentials of computer data processing..." as Fussler (154, p. 61) pointed out in 1973.

Management games, modeling, and simulation techniques are being tested (35, 62, 122, 124, 129) but have not yet received the notoriety they deserve (139). What this investigator found being collected from the operating CACS was a variation of what had been previously collected manually, except that the statistics now include a few more variables accompanied by much more data. This problem has been alluded to in the work of Lubans (71, p. 3) and, with three or four exceptions, was fairly widespread among the libraries visited during this survey.

Statistical data as a source of sophisticated operational information for management remain , therefore, an underexploited resource of middle and first line managers. Nor has it been utilized to any great extent by the top administrators. This does not stem from any inadequacy of the support hardware presently available to libraries or from the programming capability of the operators, but rather it exists as a deficiency in the original systems design. Many of the current practices in the collection and use of such information are based upon tradition and how others handled the same or similar problems. It should be pointed out, however, that all libraries visited were aware of this deficiency and expressed a strong desire to improve the statistical information on which their operations were based. It is also worth noting that many libraries called this investigators attention to their capability for capturing far more data and producing many more reports than they were currently using.

Based upon the findings developed in this report the following conclusions can be drawn:

1. There is a dimension to library automation which remains largely unexploited - the production and use of data (statistics) upon which management can base its tactical and/or strategic decision making. This does not refer to the pages of descriptive statistics which have traditionally accompanied annual reports, in one case studied here the author observed 24 pages of descriptive statistics accompanying an annual report, but to the inferential uses of statistics which enable a manager to evaluate the impact of his decisions in quantitative terms, be aware of the probability that a given event will occur or not occur, and to forecast with reasonable certainty the future impact of today's decisions.

2. The derivation and use of statistical performance measures is one of the more important technical aspects of systems planning. Yet as Foskett (53, p. 23) points out there must be some understanding of the basic theory and philosophy underlying such measures. One of the conclusions reached by this investigation is that the absence of any such theoretical base to support our current practices has resulted in the creation of a number of ad hoc performance measures which satisfy only the immediate short range needs of the library administration and are of little value in relating day to day activities to the larger perspective of library goals. Thus, although we do not yet know what are the "best performance measures, if indeed there are any such, for comparing or evaluating libraries, we at least know some that are currently in use.

The necessary theoretical underpinning to support such a philosophic rationale of library measurement lies in general systems theory, management and organizational development theory, information theory, and in the theory of measurement itself.

3. This author agrees with Evans et al. (99, p. 108) that there is no single criterion by which an observer can adequately measure the degree of success achieved by a library. Success is a composite of many factors operating over time and those who would judge the success of an enterprise must do so in an appropriate time frame basing their judgement upon suitable parameters supported by clearly articulated goals. Libraries do not lend themselves easily to the more traditional measures of success - quantitative measures - and have, therefore, often found themselves in a dilemma between the quantitative and qualitative measures of success without being able to completely accept or reject either position or to supply a rationale for their decision.

This conclusion comes both from a careful review of the parameters studied in this report - their uses, dispersion, and limitations - as well as from some of the earlier work done by Ridgway (50) on performance measures.

Libraries have shown a tendency to measure their success by the single criterion of the number of items circulated. As Ridgway points out there are very real dangers attached to the use of a single measure of success in any organization. This is especially true in libraries which contain a number of administrative subunits whose activities are interdependent, often with conflicting goals. In addition, libraries are labor intensive with high turnover rates, contain operations which see wide fluctuations in activity, and are supported by funding over which their managers have only limited control. All of these factors influence both the goals an organization can adopt as well as the performance measures it can use to gauge its success in reaching them.

4. The analogies and the disparities between the problems of management faced by private enterprise and those faced by public institutions have not yet been fully exploited. OR analytical techniques have only recently achieved widespread attention in the library milieu despite the fact that as long ago as the late fifties and early sixties, M.I.T.'s Philip Morse with his students were studying library problems. Many investigators outside the library profession have recognized in the library a rich mine of problems, ideas and analogies to the business world. Private enterprise has an historical precedent of analytical techniques tested in the empirical world of results. These have just begun to achieve acceptance by the mid-level library administrator in the small to medium sized institution.

5. Libraries need to achieve a more realistic balance between their quantifiable and non-quantifiable goals. To allow either to dominate creates an unrealistic set of performance measures not in touch with the demands of modern management. A start has been made in this direction as evidenced by the references provided in the Literature Review section of this report, but it is only a beginning and these efforts need momentum and coordination if they are to be effective. More realistic quantification of its performance measures and goals is required by libraries. Such quantification must include parameters to maximize as well as to minimize.

6. Much of the present rationale for the collection of statistical data by libraries has the appearance of being after the fact, i.e. that the statistical packages were designed w/o any stated or written purpose. After what was to be counted had been decided, a supporting rationale was developed. In many cases it would be impossible for an outside observer to look at and to interpret accurately the meaning of the statistics gathered by a library without some discussions with the librarians. Both the variables and their statistics were often a highly individualized matter created in-house, for use in-house with little attention paid to their use by or with other libraries. This makes not only their interpretation but their comparative use difficult if not impossible and leaves the problem of designing a generic MIS for academic libraries filled with ambiguities.

7. Circulation can become a computer managed operation such that a library is more responsive to the needs of its users, operators, and administrators. At the same time circulation becomes a sensitive barometer of the needs and activities taking place within the library itself.

8. A number of advances facilitating the circulation of library materials will occur within the next five years. These are patron/service/management oriented and would not be possible w/o the computer. Some of these developments have already surfaced and are being tried in libraries here and there. These have been discussed in the section of this report headed "Future Trends". As the cost of computer power comes down and patron demand increases these will spread from the larger libraries into the middle and smaller range. One of the most significant of these will be the design and implementation of a generic MIS for academic libraries.

9. The key to success in the creation of a viable MIS lies not in asking the system to produce a large and varied number of reports, which may or may not be used, but rather in the organization of whatever data is fed into the system in such a way that this data can be manipulated in a wide variety of ways by the user. Indeed, the ultimate success of the system depends not upon its ability to assimilate and then regurgitate large quantities of data but upon its ability to create on-demand different combinations of data using parameters set into the query by the user. The ideal system will be able to produce unanticipated arrangements of data after the data base has been in operation. Many of these combinations will not have been thought of during the system's design phase and the need for them will only become apparent after the system has been in operation for a time. This makes the organization, capture, and storage of data doubly important if reports not initially anticipated are to be easily drawn from the DB. To reiterate, it is not

important to the success of an MIS that a large number of reports be produced. What is of overwhelming importance is the flexibility of an information system and its ability to respond easily to the maximum number of future demands, as yet unforeseen, which will be made upon it.

10. As in most disciplines there is a gap between research and practice in library science, between what is known and the actual operating procedures. Despite the large amount of very practical OR work being done in Universities throughout the U.S. and Great Britain, the implications of OR and systems analysis as management tools does not seem to have permeated very far into the day to day operations of libraries (139). Nor do libraries as a group seem very sensitive to the findings of current research in information sciences. Some examples of this should suffice to illustrate the point. Libraries with a few exceptions continue to store all items in prime shelf space, convert collections to M/R form using a shelf list, and set loan periods for library materials based upon the status of the user, format of the material, or the anticipated use of two classes - heavy (reserve use) and less than heavy use - rather than in allowing an item to have a loan period based upon its previous history of use.

11. Finally, and for whatever solace it may bring, libraries are not alone in their management problems and data requirements. Indeed, institutions of higher education, the macrocosm for which libraries provide a splendid microcosm, are beset by the same problems. Schroeder (49) in a paper which "...surveys the development and use of management science in universities and colleges..." has generalized four problem areas to be found in institutions of higher education. Three of these are typically found in the library environment. These areas are "...investigation of decision making processes and the information which should be used, measurement of outputs, and alternative approaches to improve planning methodology,..." This investigation grappled directly with one of these problems and touched the other two in an indirect manner.

The point the author wishes to make here is that analogies between the management problems faced by libraries and by their parent institutions are often well placed and that wherever solutions have been found or research is underway into the problems of such institutions libraries should play a role as both respondent and investigator. There is a rich and as yet untapped source of information, methodology, and precedent for the library world in the work already done on quantitative performance measures in both business and higher education.

VIII. RECOMMENDATION

The following recommendations are based upon the findings in this report and the subsequent conclusions derived therefrom.

1. The state-of-the-art is such that work should begin on the development and test of a generic MIS for academic libraries. Enough commercial and educational packages are now available to supply some precedent and this author knows of at least one package designed exclusively for libraries (121) built by a major computer vendor. This parallels a recommendation made to the ARL in 1970 by Booz, Allen, and Hamilton (45, p. 47).

The Western Interstate Commission for Higher Education (WICHE) through its National Center for Higher Education Management Systems is acting as a clearinghouse for educational programs and is working at the institutional level to develop: (1) A set of meaningful institutional data, (2) a framework for organizing the data, and (3) standard methods to collect, aggregate, and display this data for purposes of information exchange. In addition, Schroeder (49) has called attention to a number of resource allocation models developed and in use for educational institutions. This work should be examined for programs which can be used in libraries.

The work of Makridakis, Hodgsdon and Wheelwright (36) on a set of programs called SIBYL-RUNNER for an interactive forecasting system to be used in applying statistical and mathematical models to sequential decision problems also merits exploration for its value in a library environment. This package uses BASIC as its programming language.

An area closely related to the above is that of simulation and modeling. Some work has already been reported on game theory and simulation for library management (35, 141), on simulation of user/funder behavior (132), on a planning model to predict library circulation (62, 140), on the difficulties encountered in modeling an information system (125), on the simulation of operating circulation systems (122), and on circulation file simulation (123) to determine "...what disc storage requirements are necessary for an on-line library circulation system...." All of this work should be examined for its applicability to academic libraries and for the design precedents it can provide to library systems designers. Many of these models have been in use long enough to provide a background of operating experience which will be helpful to others interested in the same or similar applications.

2. One of the things which a computer does best is massage and store numerical information. More ways should be developed to allow it to prepare simple traffic counts showing the number of transactions passing through a circulation system. Such tallies would be useful in staffing patterns, requirements for terminals and in long range planning for future needs.

3. The very early stages of an automation effort are the best time to overlay any system with a series of performance measures which will enable users to judge the success of the system in reaching its administrative goals and in isolating the cost parameters for the systems operation.

4. Any statistical computer package designed for libraries must be flexible enough to create reports covering whatever interval the requestor may decide. For example, the manager may request information on a daily basis or may decide to gather the same data on a weekly basis. Temporal boundaries for report periods will need to be set in by the user. In addition, any MIS should allow the data to be displayed at whatever level of detail is requested, in summary form, in cumulative form, or in selective form.

5. The design and preparation of all existing CACS statistical reports needs to be rethought. It is now difficult for a user to generate a report with the desired level of detail. The manager usually accepts whatever comes and tries either to summarize or to interpolate more detail depending upon his requirements. More flexibility is called for plus more explicit definition of a report interval and display of its dates. It is not sufficient to head a report "Annual" or "Fall Semester".

It should be possible to both explode (for detail) or collapse (for summaries) a report depending upon the amount of information desired. For example, a manager viewing a report showing a count of the number of books or items c/o by broad class schedules (first three digits of Dewey or letters of LC) should be able to explode the data into more detail and obtain for every call number (item) c/o the number of times it passed through the system. Conversely a manager viewing a table showing how many times each item was checked out should be able to collapse (summarize) this data into categories (first 3 digits of Dewey or letters of LC) and view it in summary form.

6. More attention needs to be given to the use of an error count as a useful diagnostic for the operation of computer managed systems.

7. More libraries should adopt variable due dates for items c/o as a function of the demand for that item. By using a computer it has now become possible to implement a philosophy accepted by librarians long ago but not technically feasible without a computer. It is now possible to obtain the necessary use data to control loan periods from both batch and on-line CACS such that use is maximized. Indeed, on-line systems can build into their operation self-regulating mechanisms which will allow loan periods to be established entirely as functions of past use or requests.

8. One of the major criticisms levelled at statistics gathering by public library administrators (145, p. 29) is the proclivity of statistics to be "thing-oriented" rather than user-oriented. This criticism is equally valid in the academic library environment and should be met by distinguishing clearly between effectiveness and efficiency measures to show the acceptable uses which can be made of each.

THE END

REFERENCES

1. McCann, Louise; R. McGee; and R. T. Kimber, "Comparison of Computerised Loans Systems in the United States." Program 7 (1):24-37. January, 1973.

2. McGee, R. A Literature Survey of Operational and Emerging On-Line Library Circulation Systems. ED 059 752. 1972.

3. Palmer, Richard P. Case Studies in Library Computer Systems. New York, R. R. Bowker, 1973

4. Veneziano, Velma, "An Interactive Computer-Based Circulation System for Northwestern University: the Library Puts it to Work." Jour. of Libr. Automation. 5(2):101-117. June, 1972.

5. Aagaard, J. S., "Interactive Computer-Based Circulation System: Design and Development." Jour. of Libr. Automation. 5(1):3-11. March, 1972.

6. "Northwestern University." JOLA Tech. Comm. 1:4-5. March/April, 1970.

7. Paulukonis, Joseph, "On-Line Real-Time Self-Service Circulation at Northwestern University." P. 82-93. Proceedings of the 1972 Clinic on Library Applications of Data Processing: Applications of On-Line Computers to Library Problems. F.W. Lancaster, ed. Urbana, Graduate School of Library Science, University of Illinois, 1972.

8. Dumont, Paul E., "A Library Management Information System," p. 52-53. Proc of 36th Annual ASIS Meeting, vol. 10. Ed. by H. J. Waldron and F. R. Long, Westport, Connecticut, Greenwood Press, 1973.

9. Palmer, Richard P., "Northwestern University Automated Circulation System," p. 46-57 in Case Studies in Library Computer Systems. New York, R. R. Bowker, 1973.

10. IBM - Online Library Circulation Control: Eastern Illinois University White Plains, New York, International Business Machines Corp., n.d.

11. Rao, Paladugu, and Szerenyi, B. Joseph, "Booth Library On-Line Circulation System (BLOC)." Jour. of Libr. Automation. 4(2):86-102. June, 1971.

12. Palmer, Richard P., "Booth Library, Eastern Illinois University Automated Circulation System," p. 35-45 in Case Studies in Library Computer Systems. New York, R. R. Bowker, 1973.

13. McCoy, Ralph E., "Computerized Circulation Work: A Case Study of the 357 Data Collection System." Lib. Res. Tech. Ser. 9(1):59-65. Winter, 1965.

14. Flannery, Anne, Mack, James D. Mechanized Circulation System: Lehigh University. Library Systems Analysis Report No. 4. Bethlehem, Pa., Center for the Information Sciences, Lehigh University, 1966.

15. Ackoff, Russell L., "Management Misinformation Systems," Management Science, 14(4):147-56, December, 1967.

16. Bedford, George L. An Integrated Library Circulation System. Canadian Association of Higher Education Administrative Systems Conference. Hamilton, Ontario, McMaster University, 1971, 47 p.

17. IBM. System/7-2790 Library Circulation Control: University of Pennsylvania. White Plains, New York, International Business Machines Corp., n.d.

18. Smith, Michael, Rivoire, Helena. Shelf-List Conversion. Bucknell University, 1972. 49 p. ED 094697.

19. Rivoire, Helena. Bucknell On-Line Circulation System: A Library Staff View. Bucknell University, 1973. 64 p. ED 094 698.

20. McDonough, Adrian M. Information Economics and Management Systems. McGraw-Hill, 1963.

21. Rappaport, Alfred. Information for Decision Making: Quantitative and Behavioral Dimensions. Prentice-Hall, 1970.

22. McCollum, Sue and Charles R. Sievert. The Circulation System at the University of Missouri-Columbia Library: An Evolutionary Approach. The Larc Reports, vol. 5, issue 2. 1972. 101 p.

23. Montgomery, K. L., Slater, F. L., and Belzer, Jack. "The Library Automation Network at the University of Pittsburgh," p. 155-171 in the Information Bazaar. Sixth Annual National Colloquium on Information Retrieval ed. by Louise Schultz. Philadelphia, Medical Documentation Service, the College of Physicians of Philadelphia, 1969.

24. Toombs, Kenneth F., "Light-Pen Technology at the University of South Carolina - The South Carolina Circulation System." Jour. of Libr. Automation. 7(3):226-227. September, 1974.

25. Hoadley, Irene B, and Thorson, A. R. An Automated On-Line Circulation System: Evaluation, Development, Use, Columbus, Ohio, the Ohio State University Libraries, 1973.

26. O.S.U. Libraries. Library Circulation System User's Guide. Looseleaf. Columbus, Ohio, the Ohio State University Libraries, 1972.

27. Atkinson, Hugh C., "The Ohio State On-Line Circulation System," p. 22-28. Proceedings of the 1972 Clinic on Library Applications of Data Processing: Applications of On-Line Computers to Library Problems. F. W. Lancaster, ed. Urbana, Graduate School of Library Science, University of Illinois, 1972.

28. Guthrie, Gerry D., "A Selective Statistical Study of Transaction Activity In a Large On-Line Automated Circulation System." Wash., D.C. Council on Library Resources, Grant No. CLR-571. November 28, 1973.

29. Academic Library Statistics 1973/74. Washington, D.C., Association of Research Libraries, 1974.

30. Ackoff, Russell L., "Operations Research," p. 290-294 in International Encyclopedia of the Social Sciences, David L. Sills, editor. Volume 11. New York, Crowell Collier and Macmillan, 1968.

31. Heinritz, Fred J., "Quantitative Management In Libraries," p. 157-169 in Quantitative Methods in Librarianship... edited by I. B. Hoadley and A. S. Clark. Westport, Connecticut, Greenwood Press, 1972.

32. Ward, Patricia L., "The Evaluation of Library Sciences," p. 55-85 in Studies in Library Management, edited by Brian Redfern. Volume 1. Hamden, Connecticut, Shoe String Press, 1972.

33. Buckland, Michael K., "The Management of Libraries and Information Centers," p. 335-379 in Annual Review of Information Science and Technology, edited by Carlos Cuadra and Ann Luke. Volume 9. Washington, D.C., American Society for Information Science, 1974.

34. Orr, R. H., "Measuring the Goodness of Library Sciences: A General Framework for Considering Quantitative Measures." J. Docum. 29(3): 315-332. September, 1973.

35. Brophy, Peter, et al. A Library Management Game: A Report on a Research Project. University of Lancaster Library, Lancaster, England, 1972. University of Lancaster Library Occasional Paper No. 7. Also published as ED 071 700.

36. Makridakis, Spyros; Hodgsdon, Anne; and Wheelwright, Steven C., "An Interactive Forecasting System." American Statistician 28(4):153-158. November, 1974.

37. McKibbin, Dorothy, "On-Line Circulation Control: Three Years' Experience." Canadian Library Journal. 31(3):214-230. June, 1974.

38. "Books & Bytes," Data Processor 4(2):3-6. 1974.

39. Palmer, Richard P., "University of British Columbia Automated Circulation System," p. 27-34 in Case Studies in Library Computer Systems. New York, R. R. Bowker, 1973.

40. Sanderson, M., "On-Line and Back at S.F.U." Jour. of Libr. Automation. 6(2):87-102. June, 1973.

41. "Operations Research: Implications for Libraries," Proceedings of the Thirty-Fifth Annual Conference of the Graduate Library School, August 2-4, 1971. Lib. Quart. 42(1):1-159. January, 1972.

42. Daiute, Robert J. and Gorman, Kenneth A. Library Operations Reserach. Dobbs Ferry, New York, Oceana Publications, 1974.

43. Herner, Saul. "Meaningful Statistics," p. 47-52 in Practical Problems of Library Automation. Washington, D.C., Special Libraries Association, 1967.

44. Maidment, Wm. R. "Management Information from Housekeeping Routines." Jour. of Doc. 27(1):37-42. March, 1971.

45. Booz, Allen & Hamilton. Problems in University Library Management. Washington, D.C., Association of Research Libraries, 1970.

46. McGrath, W. E. "Correlating the Subjects of Books Taken Out of and Books Used Within an Open-Stack Library." Coll. Res. Libraries 32(4):280-285. July, 1971.

47. Fussler, Herman H. and Simon, Julian L. Patterns in the Use of Books in Large Research Libraries. Chicago, University of Chicago Press, 1969.

48. Leimkuhler, Ferdinand F. and Cooper, Michael D. Analytical Planning for University Libraries. Research Program in University Administration. For Foundation Grant 68-267. Paper P-1. Berkeley, Office of the Vice President - Planning and Analysis, University of California, 1970.

49. Schroeder, Roger G. "A Survey of Management Science in University Operations." Management Science. 19(8):895-906. April, 1973.

50. Ridgway, V. F. "Dysfunctional Consequences of Performance Measurements." Admin. Sci. Quart. 1:240-248. September, 1956.

51. Lawrence, Paul R. and Lorsch, Jay W. Developing Organizations: Diagnosis and Action. Reading, Mass., Addison-Wesley Co., 1969.

52. Argyris, Chris. Understanding Organizational Behavior. Homewood, Illinois, Dorsey Press, 1960.

53. Foskett, D. J. "General Systems Theory and the Organization of Libraries," p. 10-24 in Studies in Library Management. Vol. 2. ed. by Gileon Holroyd. Hamden, Conn., Linnet Books, 1974.

54. "I Can't Believe I Did the Whole Thing." Bull. of Am. Soc. for Infor. Science. 1(9):39. April, 1975.

55. Burns Jr., Robert W. "An Empirical Rationale for the Accumulation of Statistical Information." Lib. Res. & Tech. Serv. 18(3):253-258. Summer, 1974.

56. The Ohio State University Libraries On-Line Remote Catalog Access and Circulation Control System: Part I Functional Specifications, Part II User's Manual. Gaithersburg, Maryland, International Business Machines Corporation, 1969.

57. George Fry & Associates. Study of Circulation Control Systems. Chicago, Ill., Library Technology Project of the American Library Association, 1961.

58. Nussbaum, Harvey. Operations Research Applied to Libraries. Paper Presented at Institute on Program Planning and Budgeting Systems for Libraries. Wayne State University, Detroit, 1968. 7 p. ED 045-121

59. Goldhor, Herbert. Research Methods in Librarianship: Measurement and Evaluation. Papers Presented at a Conference Conducted by the University of Illinois Graduate School of Library Science, September 10-13, 1967. Champaign, University of Illinois Graduate School of Library Science, 1968.

60. Hoadley, Irene B. and Clark, Alice S. Quantitative Methods in Librarianship: Standards, Research, Management. Procedings and Papers of an Institute Held at the Ohio State University, August 3-16, 1969. Westport, Conn., Greenwood Press, 1972.

61. Mackenzie, A. Graham and Buckland, M. K. "Operational Research," p. 224-231 in British Librarianship and Information Science 1966-1970, edited by H. A. Whatley, London, the Library Association, 1972.

62. Morse, Philip M. Library Effectiveness: A Systems Approach. Cambridge, Mass., the M.I.T. Press, 1968.

63. Overhage, Carl F. J. and Harman, R. Joyce. INTREX: Report of a Planning Conference on Information Transfer Experiements, September 3, 1965. Cambridge, Mass., the M.I.T. Press, 1965.

64. Dennis, Donald D. and Stockton, Patricia A. "Automated Library Circulation System Boosts Sciences, Control at American University." Spec. Lib. 65(12):512-515. December, 1974.

65. Goyal, S. K. "Application of Operational Research to Problem of Determining Appropriate Loan Period for Periodicals." Libri. 20(1):94-99. 1970.

66. Buckland, M. K. and Woodburn, I. "An Analytical Study of Library Book Duplication and Availability." Inform. Stor. Retr. 5(2):69-79. July, 1969. Work described earlier in University of Lancaster Library Occasional Papers, No. 2. 1968.

67. Jain, Aridaman K. et al. A Statistical Study of Book Use. Lafayette, Indiana, Purdue University, 1967. PB 176 525.

68. Arms, W. Y. and Walter, T. P. "A Simulation Model for Purchasing Duplicate Copies in a Library." J. Libr. Automat. 7(2):73-82. June, 1974.

69. Grant, Robert S. "Predicting the Need for Multiple Copies of Books." J. Libr. Automat. 4(2):64-71. June, 1971.

70. Simmons, Peter. Collection Development and the Computer. Vancouver, Canada, the University of British Columbia, 1971.

71. Lubans, Jr., John; Harper, William A.; and Erisman, Robert E. A Study With Computer-Based Circulation Data of the Non-Use and Use of a Large Academic Library. National Institute of Education, 1973. ED 082 756.

72. Cammack, Floyd and Mann, Donald. "Institutional Implications of an Automated Circulation Study." Coll. & Res. Lib. 28(3):129-132. March, 1967.

73. Morse, Philip M. and Chen, Ching-Chih. "Using Circulation Desk Data to Obtain Unbiased Estimates of Book Use." Lib. Quart. 45(2):179-194. April, 1975.

74. Brown, Charles H. and Bousfield, H. G. Circulation Work in College and University Libraries. Chicago, American Library Association, 1933.

75. Slamecka, Vladimir. "A Selective Bibliography on Library Operations Research." Lib. Quart. 42(1):152-158. January, 1972.

76. Elton, Martin and Vickery, Brian. "The Scope for Operational Research in the Library and Information Field." Aslib Proc. 25(8):305-319. August, 1973.

77. Leimkuhler, Ferdinand F. "Operations Research and Information Science - A Common Cause." JASIS. 24(1):3-8. January-February, 1973.

78. Leffler, Wm. L. "A Statistical Method for Circulation Analysis." Coll. Res. Libraries 25(6):488-490. November, 1964.

79. Morse, Philip M. "On the Prediction of Library Use," p. 225-234 in INTREX: Report of a Planning Conference on Information Transfer Experiments. Appendix N. Cambridge, Mass., M.I.T. Press, 1965.

80. Mackenzie, A. Graham and Stuart, Ian M. Planning Library Services: Proceedings of a Research Seminar Held at the University of Lancaster, July, 1969. University of Lancaster Library Occasional Papers, No. 3. University of Lancaster, 1969.

81. Buckland, M. K. et al. Systems Analysis of a University Library. University of Lancaster Library Occasional Papers, No. 4. University of Lancaster, 1970.

82. Academic Library Statistics: 1973-1974. Washington, D.C., Association of Research Libraries, 1974.

83. Hershfield, Allan F. and Boone, M. D. Approaches to Measuring Library Effectiveness: A Symposium. Frontiers of Librarianship No. 14. Syracuse, New York, Syracuse University Press, 1972.

84. Palmer, David. Measuring Library Output: A Paper Presented at an Institute on Program Planning and Budgeting Systems for Libraries at Wayne State University, Detroit, Michigan, Spring, 1968. 17 p. ED 045 118.

85. De Prospo, Ernest R. and Altman, Ellen. "Another Attempt at Measuring Public Library Effectiveness: Some Methodological Considerations," p. 14-30 in Approaches to Measuring Library Effectiveness, edited by Allan F. Hershfield and M. D. Boone. Syracuse, New York, Syracuse University, 1973.

86. Foil, Patti Sue. A Comparative Study of Data Collection Systems for Computer-Based Library Circulation Processes. M. S. Thesis. Mississippi State University. December, 1974.

87. Salverson, Carol A. "The Relevance of Statistics to Library Evaluation." Coll. & Res. Libr. 30(4):352-361. July, 1969.

88. Krikelas, James. "Library Statistics and the Measurement of Library Services." ALA Bull. 60(5):494-99. May, 1966.

89. Moravec, A. F. "Basic Concepts for Designing a Fundamental Information System." Management Services. 2(4):37-45. July-August, 1965.

90. Association of Research Libraries. Minutes of the Eighty-Fifth Meeting, January 18, 1975. Washington, D.C. A.R.L., 1975.

91. Harris, Robert. "Circulation Control in the U.B.C. Library," p. 93-96 in Automation in Libraries. Papers Presented at the C.A.C.U.L. Workshop on Library Automation, at the University of British Columbia, Vancouver, April 10-12, 1967. Canadian Association of College and University Libraries, 1967.

92. Beckman, Margaret and Brown, Nancy Ann. "The Role of the Librarians in Management." Spec. Libraries. 66(1):19-26.

93. Axford, H. Wm. Proc. of the LARC Institute on Library Operations Research Held Jan. 25-26, 1973. Tempe, Arizona, LARC Assoc., 1973. 83 pp.

94. "On-Line, Real Time Circulation: A Report on the Northwestern University Library System." LARC Reports 3(4):3-54. Winter, 1970-71.

95. Stock, Karl F. Grundlagen Und Praxis Der Bibliotheksstatistik. Munchen, Verlag Dokumentation Pullan Bei Munchen, 1974. p. 313-361.

96. Kraft, Donald. "Library Operations Research," p. 19-62 in Proceedings of the LARC Institute on Library Operations Research, January 25-26, 1973. Tempe, Arizona, LARC Association, 1973.

97. National Academy of Sciences, Information Systems Panel. Libraries and Information Technology: A National System Challenge. Washington, D.C. N.A.S., 1972.

98. Wessel, C. J. et al. Criteria for Evaluating the Effectiveness of Library Operations and Services. Phase I, Literature Search and State of the Art, AD 649-468, February, 1967; Phase II, Data Gathering and Evaluation, AD 676-188, August, 1968; Phase III, Recommended Criteria and Methods for their Utilization, AD 682-758, January, 1969. Springfield, Va., Clearinghouse for Federal Scientific and Technical Information.

99. Evans, E.; Borko, H.; and Ferguson, P. "Review of Criteria Used to Measure Library Effectiveness." Bull.Med. Lib. Assoc. 60(1):102-10. January, 1972.

100. American Library Association, Circulation Control Committee of LAD Section on Circulation Services. Circulation Policies of Academic Libraries in the United States, 1968. Chicago, A.L.A., 1970.

101. Bush, G. C.; Galliher, H. P.; and Morse, P. M. "Attendance and Use of the Science Library at M.I.T." Am. Doc. 7(1):87-109. January, 1956.

102. Stangl, Peter and Kilgour, Fred G. "Analysis of Recorded Biomedical Book and Journal Use in the Yale Medical Library." Bull. Am. Med. Assoc. 55:301-315. 1967.

103. Kennedy, Robert A. "Bell Laboratories On-Line Circulation Control System: On Year's Experience," p. 14-30 in Proceedings of the 1969 Clinic on Library Applications of Data Processing Urbana, Graduate School of Library Science, University of Illinois, 1970.

104. Randall, Gordon E. "Randall's Rationalized Ratios" Spec. Libr. 66(1):6-11. January, 1975.

105. Rudolph, G. A. editor. The Academic Community Looks at Library Management, A Conference Held 13 November 1971 by the Carol M. Newman Library and the Department of Industrial Engineering and Operations Research Blacksburg, Virginia, Virginia Polytechnic Institute and State University, 1972.

106. White, John A. "Operations Research in Library Management," p. 21-48 in the Academic Community Looks at Library Management, Proc of a Conference, Virginia Poly. Inst., Blacksburg, Va., November, 1971. See reference 105.

107. Trueswell, Richard L. "Some Behaviorial Patterns of Library Users: the 80/20 Rule." Wilson Lib. Bull. 43(5):458-461. January, 1969.

108. Trueswell, Richard L. "User Circulation Satisfaction vs. Size of Holdings at Three Academic Libraries." Coll. Res. Libr. 30(3):204-213. May, 1969.

109. Guthrie, Gerry and Yagello, Virginia. The Effect of Reduced Loan Periods on High Use Items. Unpublished Research Report. The Ohio State University Libraries, n.d.

110. Orr, Richard H. et al. "Development of Methodologic Tools for Planning and Managing Library Services: III, Standardized Inventories of Library Services." Bull. Med. Libr. Assoc. 56:380-403. 1968.

111. Rzasa, Philip V. and Baker, Norman P. "Measures of Effectiveness for a University Library." JASIS, 23(4):248-253. July-August, 1972.

112. Rzasa, Philip V. and Moriarty, John H. "The Types and Needs of Academic Library Users: A Case Study of 6,568 Responses." Coll. Res. Libr. 31(6):403-409, November, 1970.

113. Andrews, Theodora. "The Role of Departmental Libraries in Operations Research Studies in a University Library: Part 1. Selection for Storage Problems. Part 2. A Statistical Study of Book Use." Spec Libr. 59:519-524, 638-644. 1968.

114. Radford, Neil A. "The Problems of Academic Library Statistics," Lib. Quart. 38(3):231-248. July, 1968.

115. Miller, Laurence. "The Role of Circulation Services in the Major University Library." Coll. Res. Libr. 34(6):463-471. November, 1973.

116. Miller, Jean K. "Computer Assisted Circulation Control at Health Sciences Library SUNYAB." Jour. of Libr. Automation. 5(2):87-95. June, 1972.

117. Ford, Geoffrey. "Research in User Behavior in University Libraries." Jour. of Doc. 29(1):85-112. March, 1973.

118. Buckland, M. K. and Hindle, A. "Loan Policies, Duplication and Availability," p. 1-15 in Planning Library Services edited by A. Graham Mackenzie and I. M. Stuart. See Reference 80 for full citation.

119. Burkhalter, Barton R. and Pace, P. A. "An Analysis of Renewals, Overdues and Other Factors Influencing the Optimal Charge-Out Period," p. 11-33 in Case Studies in Systems Analysis in a University Library. Metuchen, N.J., the Scarecrow Press, 1968.

120. Trueswell, Richard L. "A Quantitative Measure of User Circulation Requirements and its Possible Effect on Stack Thinning and Multiple Copy Determination." Am. Doc. 16(1):20-25. January, 1965.

121. Alexander, Robert W. Library Management System (LMS): Descriptive Specifications for an On-Line Real-Time Integrated Library System. Los Gatos, California, International Business Machines Corporation, 1968.

122. Buckland, Michael K. "An Operations Research Study of a Variable Loan and Duplication Policy at the University of Lancaster," Lib. Quart. 42(1):97-106. January, 1972.

123. Hudson, R. F. B. Simulation of an On-Line File for a Lib[illegible]ulation System. South West University Libraries Systems Co-operati[illegible]oject, University of Bristol, 1973.

124. Beckman, Margaret. Derivation of a Simulation Model of a University Library System. Research Report No. 1. The Library, University of Guelph, n.d.

125. Martyn, J. and Vickery, B. C. "The Complexity of the Modelling of Information Systems," Jour. of Doc. 26(3):204-220. September, 1970.

126. Pritchard, A.; Auckland M.; and Castens, M. Library Effectiveness Study. City of London Polytechnic, Library and Learning Resources Service, May, 1973.

127. Griffen, Agnes M. and Hall, John H. P. "Social Indicators and Library Change." Lib. Jour. 97(17):3120-3123. October 1, 1972.

128. Kaske, Neal Kermit. Effectiveness of Library Operations: A Management Information Systems Approach and Application. Ph.D. Thesis, Norman, Oklahoma. University of Oklahoma, 1973.

129. Hamburg, Morris et al. Library Planning and Decision-Making Systems. Cambridge, Mass. M.I.T. Press, 1974.

130. McGee, Rob. "Key Factors of Circulation System Analysis and Design." Coll. Res. Libr. 33(2):127-139. March, 1972.

131. Association of Research Libraries. Report of ARL-ACRL Joint Committee on University Library Standards. Revised by Clifton Brock, et al., ARL, n.d.

132. Baker, Norman R. and Richard E. Nance. "Organizational Analyses and Simulation Studies of University Libraries: A Methodological Overview," Info. Stor. and Retrieval 5(4):153-68. February, 1970.

133. Buckland, Lawrence F.; Dolby, James; and Madden, Mary. Survey of Automated Library Systems, Phase I. Final Report. Inforonics, Inc., April 13, 1973. ED 078 849

134. Guthrie, Gerry D. "An On-Line Remote Catalog Access and Circulation Control System," p. 305-09. Proceedings of the American Society for Information Science. Vol. 8. Westport, Connecticut, Greenwood Publishing Co., 1971.

135. Simmons, Peter. "Improving Collections through Computer Analysis of Circulation Records in a University Library," p. 59-63. Proceedings of the American Society for Information Science. Vol. 7. Washington, D.C., A.S.I.S., 1970.

136. Meier, Richard L. "Efficiency Criteria for the Operation of Large Libraries." Lib. Quart. 31(3):215-234. July, 1961.

137. Bruce, Dan R. "Measure and Standard in the University Library," Canad. Libr. Jour. 31(1):28-36. January/February, 1974.

138. Beasley, Kenneth E. A Statistical Reporting System for Local Public Libraries. Pennsylvania State Library Monograph No. 3. University Park, Pennsylvania State University, 1964.

139. Bommer, Michael. "Operations Research in Libraries: A Critical Assessment," JASIS. 26(3):137-139. May-June, 1975.

140. Rouse, William B. "Circulation Dynamics: A Planning Model." JASIS. 25(6):358-363. November-December, 1974.

141. Thomas, Pauline A. and Robertson, Stephen A. "A Computer Simulation Model of Library Operations," Jour. Doc. 31(1):1-18. March, 1975.

142. Pritchard, Alan. The Library as an Industrial Firm: An Approach to Library Management. City of London Polytechnic, Library and Learning Resource Service, December, 1973.

143. Kershner, Lois M. "Management Aspects of the Use of the IBM System/7 in Circulation Control," p. 43-54 in Proceedings of the 1974 Clinic on Library Applications of Data Processing. Urbana-Champaign, University of Illinois, Graduate School of Library Science, 1974.

144. Institute for Operational Research. The Scope for OR in the Library and Information Services Field. OSTI Report 5136. Office of Scientific and Technical Information, United Kingdom, 1972.

145. De Prospo, Ernest R. et al. Performance Measures for Public Libraries. Chicago, Americal Library Association, 1975.

146. Baumol, William J. and Marcus, Matityahu. Economics of Academic Libraries. Washington, D.C. American Council On Education, 1973.

147. Wasserman, Paul. "Measuring Performance in a Special Library - Problems and Prospects," Spec. Libr. 49:377-382. October, 1958.

148. Lazorick, Gerald J. Demand Models for Books in Library Circulation Systems. Office of Science Information Service, National Science Foundation, 1970. PB 192275.

149. Gherman, Paul et al. Faculty Loan Regulations in ARL Academic Libraries. University Libraries Technical Paper No. 4. Detroit, Wayne State University, May, 1973. ED 082792.

150. Schoderbek, Peter P. Management Systems. 2nd ed. New York, Wiley, 1971.

151. De Prospo, Ernest; and Altman, Ellen. "Library Measurement: A Management Tool." Lib. Jour. 98:3605-3607. 15 Dec. 73.

152. Pinzelik, Barbara P., and Tolliver, Don L. Statistical Collection Simplified Within the Purdue General Library. Part 1. Purdue University, 1972. ED 068 112.

153. Beeler, M. G. Fancher et al. Measuring the Quality of Library Service: A Handbook. Metuchen, N.J., Scarecrow Press, 1974.

154. Fussler, Herman H. Research Libraries and Technology. Chicago, the University of Chicago Press, 1973.

Table 1.

QUANTITATIVE PERFORMANCE MEASURES AND THEIR USE IN THE TWENTY-FOUR ACADEMIC LIBRARIES SURVEYED

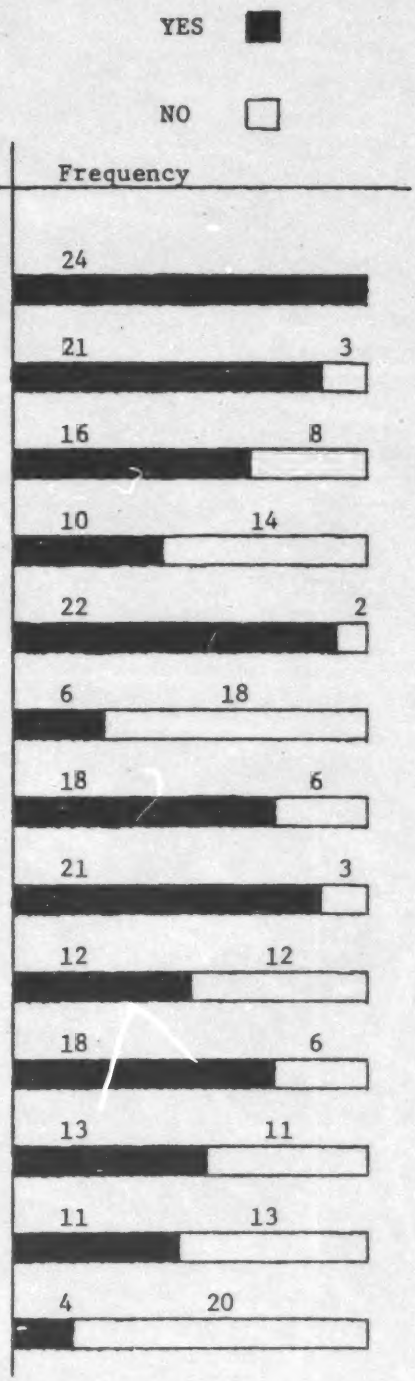


Table 1. (Con't)

QUANTITATIVE PERFORMANCE MEASURES AND THEIR USE IN THE TWENTY-FOUR ACADEMIC LIBRARIES SURVEYED

Variable	Frequency	
B. Status of Borrower Compared With Another Variable for Charges	13	11
C. Number of System Errors	14	10
D. Can this System Show the Number of Charges Made by Hour of Day (Highest Hour)	8	16
E. The Number of Holds Placed	16	8
F. Frequency Distributions of Data Showing Either Per Item Use or Per Person Uses	7	17
G. Reports are Prepared Which Show File Size (Number of Items Out) As of a Given Day	21	3

Table 2a.

AGGREGATE OF ALL REPLIES TO QUESTION,
"HOW SATISFIED ARE YOU WITH THE STATISTICAL MANAGEMENT
DATA YOU COLLECT FROM YOUR AUTOMATED CIRCULATION SYSTEM?"

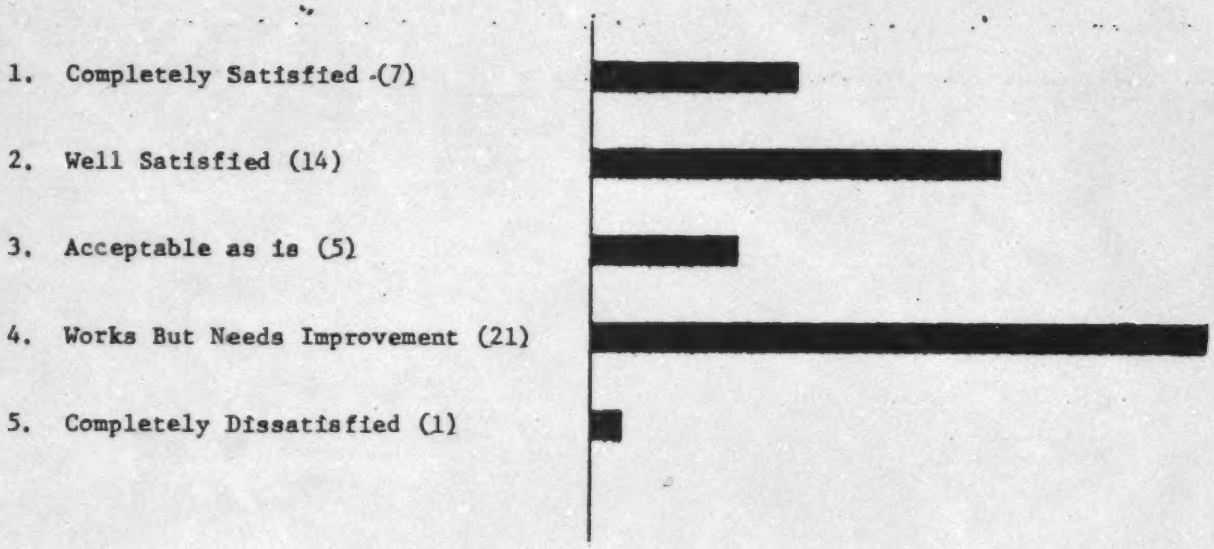

1. Completely Satisfied (7)
2. Well Satisfied (14)
3. Acceptable as is (5)
4. Works But Needs Improvement (21)
5. Completely Dissatisfied (1)

Table 2b.

PERCENTAGE OF ALL REPLIES BY POSITION (STATUS) OF RESPONDENT TO QUESTION, "HOW SATISFIED ARE YOU...?"

Position			Percent of Replies for this Position	
1. Library Directors		(14)		29%
Completely Satisfied	(2)		14%	
Well Satisfied	(5)		36%	
Acceptable as is	(2)		14%	
Works But Needs Improvement	(5)		36%	
Completely Dissatisfied	(0)		0%	
2. Asst./Assoc. Directors and Others		(9)		19%
Completely Satisfied	(0)		0%	
Well Satisfied	(4)		44%	
Acceptable As is	(0)		0%	
Works But Needs Improvement	(5)		56%	
Completely Dissatisfied	(0)		0%	
3. Head or Asst. of Circulation Dept.		(18)		37%
Completely Satisfied	(4)		22%	
Well Satisfied	(4)		22%	
Acceptable as is	(3)		17%	
Works But Needs Improvement	(6)		33%	
Completely Dissatisfied	(1)		5%	
4. Librarian Responsible for Systems		(7)		15%
Completely Satisfied	(1)		14%	
Well Satisfied	(1)		14%	
Acceptable as is	(0)		0%	
Works But Needs Improvement	(5)		71%	
Completely Dissatisfied	(0)		0%	
	48	48	100%	100%

Table 3.

REPORTING CYCLES PRESENTLY IN USE BY LIBRARIES
AND THEIR FREQUENCY OF OCCURRENCE

Cycle*	Number of Libraries Which Used This Cycle
Daily	19
Twice a Week	1
Three Times a Week	2
Weekly	7
Monthly Summaries	15
Month to Date	5
School Term	7
Six Month	3
Annual Totals†	11
Year-to-Date	1
On Demand	18

† Academic Year, Fiscal Year, or Calendar Year.

* See discussion and definitions of cycles in Findings Part B, Item 19.

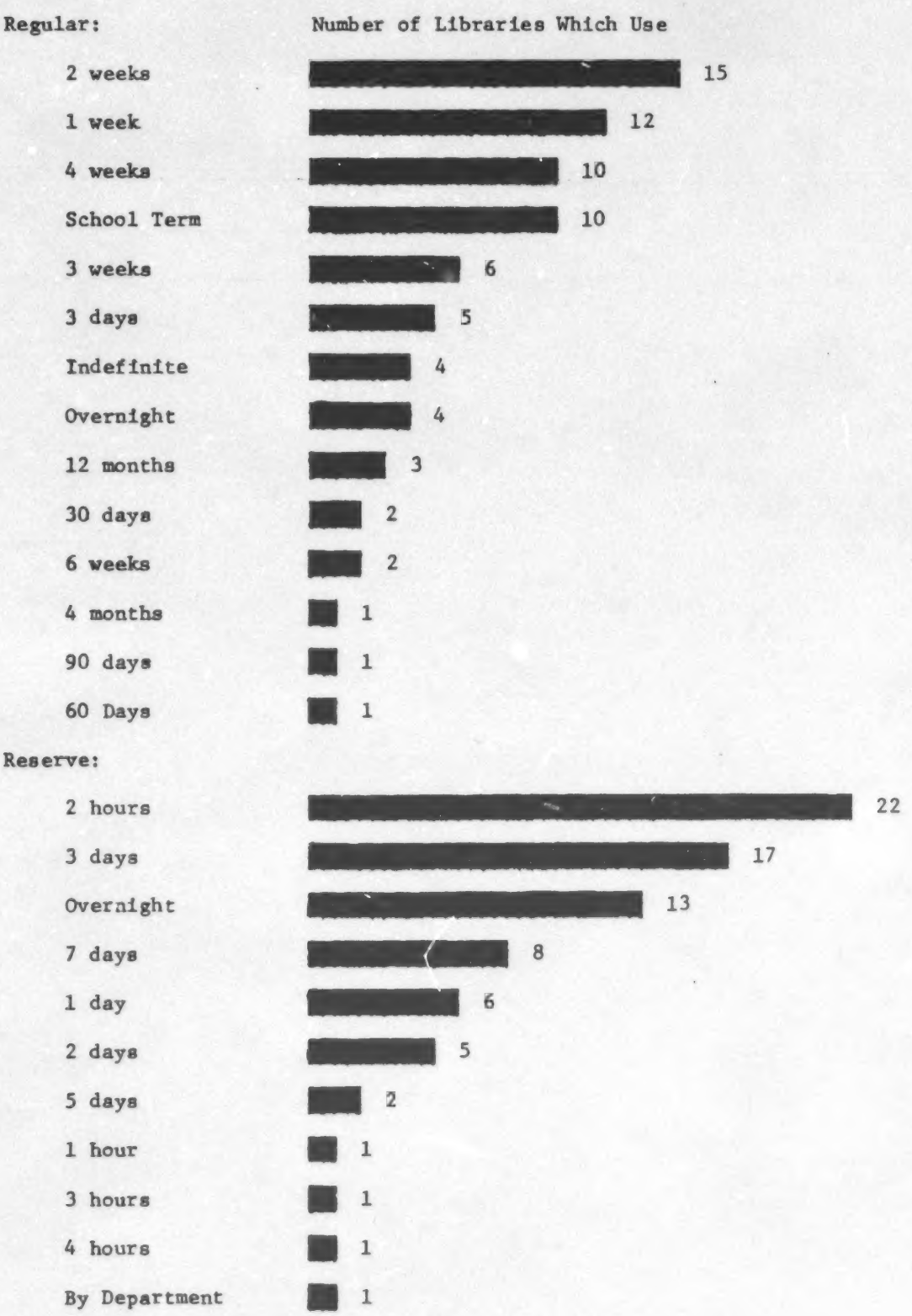
Table 4

HARDWARE USED BY OR SUPPORTING EXISTING COMPUTER DRIVEN CIRCULATION SYSTEMS IN BATCH, ON-LINE, OR QUASI-BATCH MODES

LIBRARY	Computer on Which Library Processing is Done		Data Capture Performed By							Interactive	Processing Mode		
	In Library	Outside Library	IBM357	IBM1030/1	C-Dek	Light pen	IBM2791	CRT	Teletype		Batch	On-Line	Combined
1.		370	Y							N	Y		
2.		360	Y							N	Y		
3.		360		Y				Y		Y			Y
4.		370						Y		Y		Y	
5.		370			Y					N	Y		
6.		370		Y				Y		Y		Y	
7.	PDP 11					Y		Y		Y		Y	
8.		CDC6400	Y							N	Y		
9.		370			Y					N	Y		
10.	System 7	370					Y			Y			Y
11.	PDP 8	Sigma 7						Y	Y	Y			Y
12.		370					Y		Y	Y			Y
13.		360	Y							N	Y		
14.	System 7	370					Y		Y	Y			Y
15.		360		Y						N	Y		
16.	Honeywell 316 Mini	DEC 10		Y				Y	Y	Y			Y
17.		360			Y					N	Y		
18.		370			Y					N	Y		
19.	PDP 11	370				Y		Y		Y			Y
20.		370						Y	Y	Y		Y	
21.		360 and 370		Y				Y	Y	Y			Y
22.		370		Y						N	Y		
23.	PDP 11	370		Y						N	Y		
24.		370		Y						N	Y		

Table 5,

LOAN PERIODS IN USE BY THEIR FREQUENCY OF OCCURRENCE



Date

School

APPENDIX A

INTERVIEW CHECK SHEET

Basic Checklist

Interviewee

1. Obtain From each School:

   a. Copy of most recent annual report of director.
   b. Copy of most recent annual report from Circulation Librarian.
   c. Copies of circulation related reports (internal).

   Discover how often they are issued and how cumulated.

2. How satisfied are you with the statistical management data (numerical data used by the library manager/administrator in their decision making activities) you collect from your automated circulation system?

	Director	Circ Head	Other
Completely Satisfied	___	___	___
Well Satisfied	___	___	___
Find It Acceptable As Is	___	___	___
System Works But Needs Improvement	___	___	___
Completely Dissatisfied	___	___	___

3. Can you name some Specific Uses Which You Make of this Data?

Table 1. General Information About the School/Library.

Student Body Count
    FTE
    Head Count
Libraries Total Annual Operating Budget
Items In the Collection
Uses Semester or Quarter System
Classification Scheme(s) Used
Regular Loan Periods
Is Reserve Circulation Handled by the Computer. (Do items go through a terminal for reserve loan periods?) Do not count here items c/o through the computer to Reserve.
Reserve Loan Periods
Collects Statistics Both Manually and by CACS
Uses Accession Number to uniquely identify each piece
References on CACS
Uses a transaction or control # to uniquely identify each charge transaction.

Table II. General Background Information, CACS Operating Characteristics, Equipment Used, and Examples of Reports (Both Narrative and Numerical) Obtained from CACS.

A. Background information.

1. Date when present CACS* first became operational/installed.

2. General description of CACS operation

3. Typical throughput each day on CACS*
   Est. High Day
   Est. Low Day

4. Number of items passed annually through CACS* for the year____ (most recent).

5. Types of Library Materials Which are Handled by the CACS.

B. Operating characteristics of CACS.

1. On/Off line.

2. Batch mode.

3. Interactive.

4. Input source (cards, tape, CRT).

5. Is Self-service c/o performed.

6. Are all circulating items which would normally be handled by CACS in M/R form as of the date of the survey.

7. Is there a manual backup.

8. How often are update runs made.

9. Each book card contains

10. Reporting cycles (this is the interval at which the reports are issued not necessarily the period covered by the report)

C. Equipment

1. University computer on which library processing is done.

2. Terminals used.

3. Computer (system) used by library in-house.

---

* CACS = Computer Assisted Circulation System

D. Examples of reports provided on P/O.

1. General description or titles of reports.

a. P/O of all titles in circulation.

b. Overdue items (list and/or notices made).

c. Analysis of length of loans made to faculty members.

d. Analysis of reserve use.

e. List of missing or lost items.

f. List of titles which have circulated more than X times.

g. List of titles on reserve.

h. Correlating book use statistics with student grades, test scores, and other data.

i. Call-in to present holder of item.

j. List or notices of items overdue.

k. Inventory list of everything an individual has out.

l. List of all titles (arranged by call #) showing for each volume the number of times that volume was c/o during the year.

m. List of billed books (books for which a bill has been made).

n. List of items renewed.

o. List of items recalled from borrowers.

p. List of errors/problems in system.

q. Books in mending.

Table III. Varieties of Numerical Information with their Temporal Frequency/ Boundaries as Generated by CACS.

A. CACS system tallies and reports the count of

1. Items which have been checked-out.

a. During a given time span.

b. By category of loan period (2 hrs, 14 day, Qtr., Month, etc.)

c. By type (status) of user.

d. By status of borrower c/tab with type (category of loan) of transaction (2 parameter table).

e. By type (physical format) of material taken. Book, journal, thesis, etc.

f. By call number classification (broad categories).

g. To a special location. Reserve, bindery, cataloging, home use, seminar room, storage, reference, etc.

h. Through a given terminal by terminal designation or from a special location other than main circulation desk.

i. Total number out (file size) as of a given day.

2. Items returned (checked-in) during a given interval.

3. Items renewed as a separate category.

4. Items asked for but not available (Holds).

5. Items overdue (both notices sent and items overdue).

6. Items fined, billed, or both billed and fined, or items for which notices were sent/printed.

7. Frequency distribution showing number of books which have had X c/o. For example 1318 items have been checked out between 0 and 4 times.

8. Number of system errors. For example, returns w/o matching charges, etc.

9. Charges made from undergraduate library or separate stations outside main building.

10. Items withdrawn from the collection.

11. Items reported lost.

12. Is it possible to determine the highest hour in a day of c/o made thru the system.

APPENDIX B

LIST OF LIBRARIES SURVEYED WITH DATES - STAFF INTERVIEWED

Institutions of Library Visited	Date(s) of Visit (1975)	Staff Interviewed	References from Literature
1. Alberta, University of	May 26	3	
2. American University	March 27	2	64
3. Bowling Green State University	March 19	2	
4. British Columbia, University of	May 22	3	39,70,94,135
5. Bucknell University	April 9	4	18, 19
6. Eastern Illinois University	February 6	2	10,11,12
7. George Washington University	March 28	2	
8. Georgetown University	March 27	1	
9. Guelph, University of	April 3	2	92,124
10. Houston, University of	January 15	2	
11. Lehigh University	April 10	2	14,
12. Manitoba, University of	May 27	1	37,38
13. McMaster University	April 1	1	16
14. Missouri, University of	February 3/4	3	22
15. Northwestern University	February 5	4	4,5,6,7,9,94
16. Ohio State University	March 17/18	4	25,26,27,28,56,134
17. Pennsylvania, University of	April 7/8	3	17,143
18. Pittsburg, University of	March 20/21	4	23
19. Rice University	January 16	3	
20. San Antonio College	January 13	1	8
21. Simon Fraser University	May 20	4	40
22. Southern Illinois University	February 7	3	13
23. South Carolina, University of	March 26	1	24
24. Washington University (St. Louis)	April 11	2	
25. York University (Telephone Interview)	April 4	1	